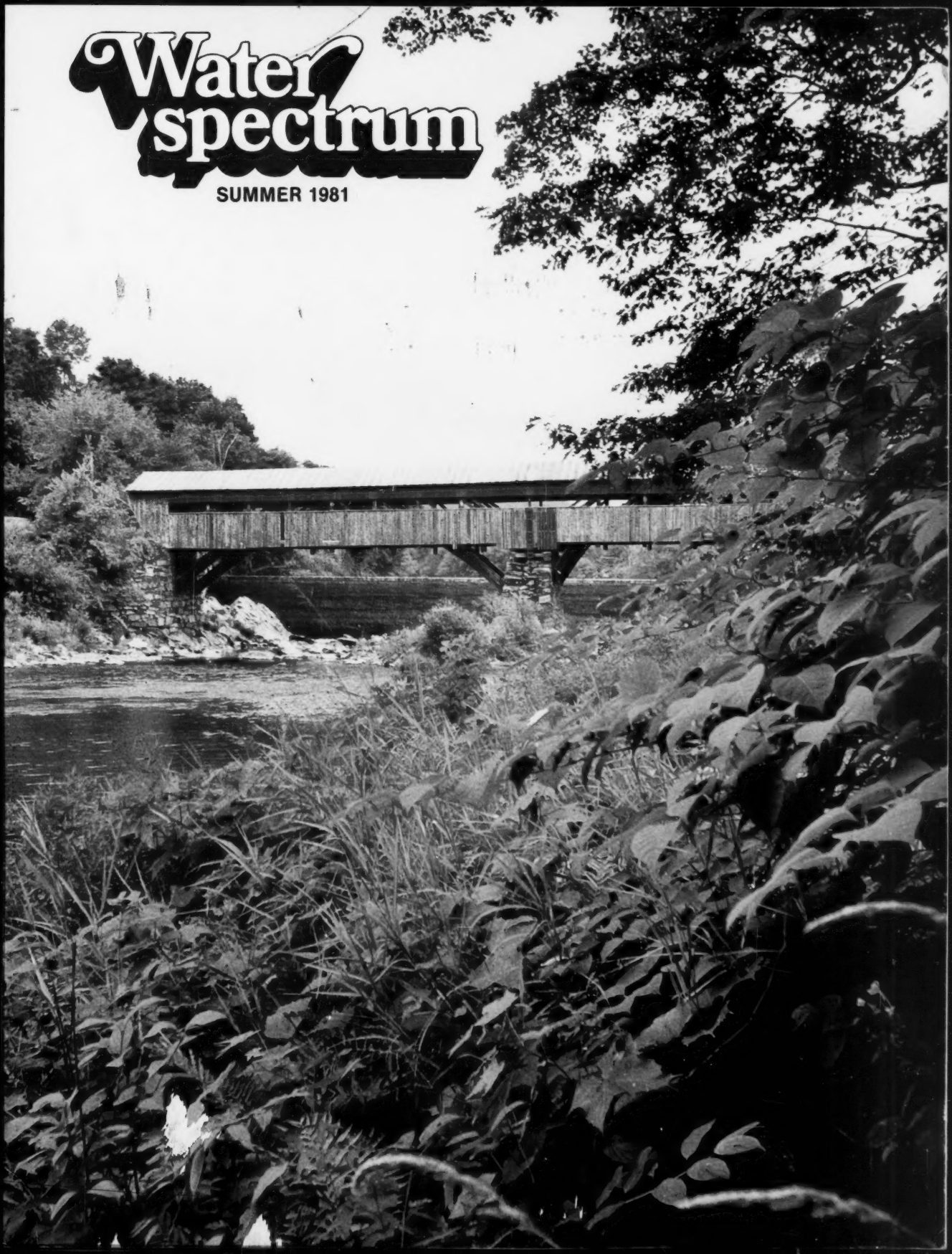
Water spectrum

SUMMER 1981



Water spectrum

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COVER: "Sweet Echo, sweetest nymph, that liv'st unseen
Within thy airy shell
By slow Meander's margent green,
And in the violet-embroider'd vale." —John Milton
(Photo by Bill Harrison.)

The landscape depends upon the maintenance of natural processes and the diversity of life forms.
(Corps of Engineers photos.)

RESOURCE MANAGEMENT: Challenges for the Eighties

by Laurence R. Jahn

Recent studies, including the Global 2000 Report to former President Carter, identified the links among explosive human population growth, inadequate natural resource policies, and lack of effective conservation programs to prevent further environmental degradation. Approaches to evaluate *all* resource values, in dollars and beyond, in proposed developments are authorized and procedures are being developed to apply them in field situations. They are being designed to implement the two coequal national objectives established with the 1969 National Environmental Policy Act: economic development and environmental quality.

Before 1970 there was only one national objective, economic development. Cost-benefit calculations were used to assist decision makers in reaching conclusions. Values beyond dollar expression—such as fish, wildlife, trees, and other natural values—were largely ignored. Economists called those values "externalities" (outside the market valuation system). Thus, important values, and frequently those held under the public trust doctrine of law, were ignored and sacrificed.

Response has been slow in realigning procedures to encompass both national objectives. Principles and standards for evaluating proposed water and associated land developments were first issued by the U.S. Water Resources Council

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Before 1970, values beyond dollar expression were largely ignored.

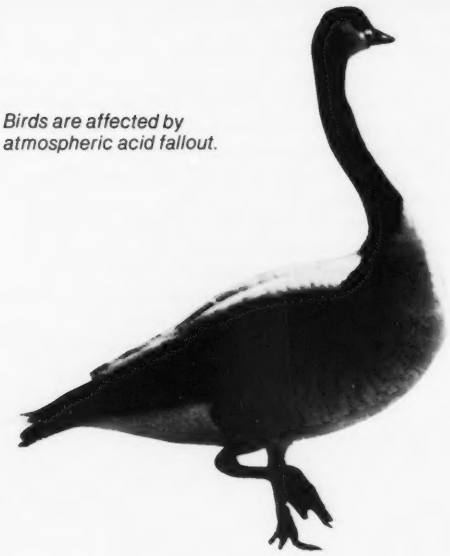
in 1973. Agencies have been slow to adopt the new concepts and develop new planning procedures. In fact, those procedures remain to be completed and implemented in the 1980s. They hold promise for helping develop the perception of limits on human populations and guidelines for landscape exploitation to avoid and minimize adverse consequences. The pressing challenge is to make sure evaluation procedures employed ensure an analysis and display of environmental impacts under designated alternatives for each development before it is undertaken. With the preventive dimension used broadly, more balanced use of the resource base should occur, with a minimum of costly mistakes and expensive restoration efforts. The landscape depends upon the maintenance of natural processes and the diversity of life forms. These are jeopardized through man's excessive exploitation and habitat destruction.

For many years, resource managers have wished for an awakening of the conservation ethic in the minds of citizens. That awakening has taken place. Managers now must recognize that it is time to move forward with well-designed management programs. The challenge for the 1980s is to respond to the warnings and conduct affairs in a more sensitive manner and in a preventive framework.

CHEMICAL CONTAMINATION

Ways must be found to reduce chemical contaminants and avoid their adverse impacts on living organisms. Acid precipitation is a major environmental problem on both sides of the Atlantic Ocean. In the eastern half of the U.S. the acidity of rainfall appears to have increased about fiftyfold during the past 25 years, according to a 1979 Council on Environmental Quality study. Similarly, the affected geographic area has enlarged. This is a result of acidic substances produced in the atmosphere when sulfur dioxide and nitrogen oxides from fossil fuel and vehicle combustion combine with oxygen to yield sulfuric and nitric acids. These pollutants are carried hundreds to thousands of miles from their primary sources—tall stacks at power plants in highly industrial, coal-based regions. Acid precipitation in one state or region of the U.S. or Canada results in large part from emissions in regions many miles away.

Initial research indicates that large areas of Minnesota, Wisconsin and upper Michigan have characteristics that make them as susceptible to acid precipitation as the Adirondack lakes in New York. Mercury levels in fish, which increase as lakes become more acidic, already are high in some lakes in the northcentral and northeast areas. On the terrestrial side, white pine and quaking aspen are sensitive to gaseous emissions from coal-fired power plants and high ozone concentrations from industrial and municpal emissions. Both of these trees are prevalent in the Boundary Water Canoe Area and Voyageurs National Park in northern Minnesota as well as in nearby areas of Canada. Despite decades of continuing efforts to maintain these two national areas in pristine condition, they now are threatened with chemical fallout that has the potential to degrade and destroy their living resources.



Birds are affected by atmospheric acid fallout.

A lowering of pH has drastic impacts on terrestrial and aquatic living resources. At pH value 4.5 reproduction of many species of aquatic organisms is inhibited, and below that pH level populations of many freshwater fish become extinct. Crayfish, snails and other crustaceans with a high calcium demand are among the earliest to disappear from acidified lakes. Even fragmentary data show the responses of birds to atmospheric acid fallout. Pairs of ospreys search for food in lakes that have no fish, and then are not seen there. Wading birds such as blue herons that depend upon small organisms for food are likely to be affected. Nesting adult loons apparently survive by using other lakes in the area, but young that are hatched on fishless lakes do not survive.

The challenge is to respond to the national need to use more coal and the equivalent pressing need to prevent degradation of the environment. Ways must be found to curtail and avoid the acid precipitation threat. It is clear that the threat is substantial. In Ontario, Quebec, New York, New England and the Maritime Provinces, acidification of aquatic areas is increasing and may continue to curtail biological productivity until acid inputs decrease significantly. In other areas, it seems best to prevent release of chemicals that cause resource degradation.

Control of fossil energy emissions appears to be feasible and cost-effective, and there are three main approaches:

- clean the gas discharges before they leave exhaust stacks;
- remove sulphur from coal before or as it is used;
- use clean coal, such as that available from the western U.S. and Canada.

Full implementation of these approaches is awaited to register accomplishments. Once the acid fallout ends, living organisms can be restored through nature's normal recovery processes and man's transplantation efforts. Such intensive management will be required, especially on landlocked lakes in which species have become extinct.

Meanwhile, wildlife and fisheries managers need to examine the biological productivity of surface water areas carefully to make certain that harvest regulations are ensuring sustained yields under potential and, in some areas, reduced reproductive gains.

Other chemicals continue to have adverse impacts on reproduction and survival of wildlife. In the Great Lakes—the largest single volume of fresh surface water in the world—nearshore areas of all the lakes have localities of deteriorated water as a result of high loads of phosphorus and nitrogen. Persistent toxic chemicals also remain a significant residual problem even after the manufacture or use of some toxic chemicals has been stopped. This problem results from their persistence and biomagnification in food chains as well as from the generally slow flushing rates of the Great Lakes. Though banned in 1972 and decreasing in fish flesh, DDT remains as a residual contaminant. PCB's readily accumulate in fatty tissues and can continue as a threat to lower reproduction of fish-eating birds, especially herring gulls. These conditions dictate that programs and efforts be pursued, especially in the next decade, to reduce and prevent pollution and thereby restore and improve water quality.

WATER

Better water conservation and management is needed to help reduce and avoid further demands for water. Guidelines on water withdrawals, particularly for consumptive purposes and transport, must be applied broadly to help ensure minimum flows in streams, desirable minimum levels in lakes and reservoirs, and fresh water inflows to estuaries. Only through effective application of such guidelines can species and populations of fish and wildlife be maintained on a sustained-yield, multiple-benefit basis. Although minimum flow and minimum level water problems currently are most pressing in the west, they are becoming problems nationwide. The challenge is to design and install guidelines that prevent those problems from becoming more serious or more widespread.

Stronger and more effective programs are needed to maintain and restore wetlands.

WETLANDS

Stronger and more effective programs are needed to maintain and restore wetlands. For far too long, wetlands have been considered wastelands. They have been drained or filled and converted to other uses, often with technical and financial assistance through various governmental programs, including those for navigation, flood control, and agricultural development. Not only were the economics unsound, but a wide array of public values associated with wetlands was being sacrificed in the process. Costs associated with those losses, particularly of public values, were largely ignored. Even today, the U.S. Department of Agriculture states that all domestic and some export food and fiber needs after the year 2000 can be provided without sacrificing important aquatic areas.

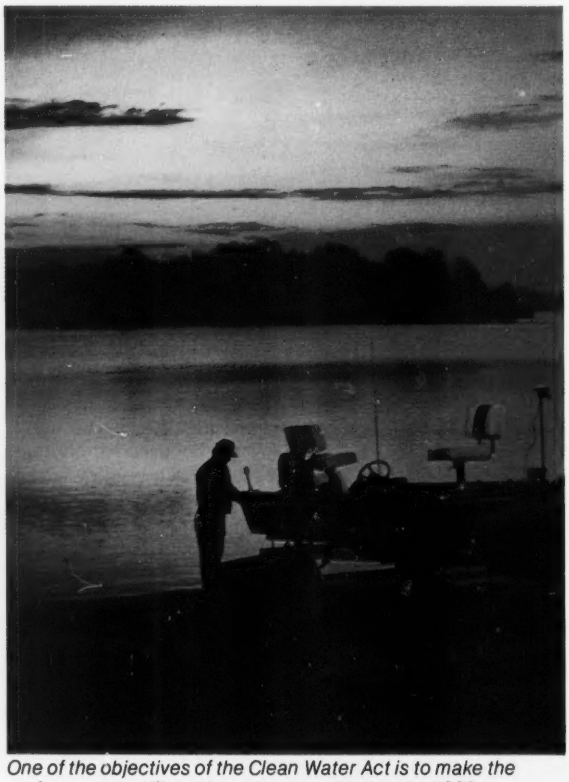
Seeking wider recognition are the invaluable hydrologic values of wetlands, such as floodwater storage. A Minnesota report recently highlighted the importance of this wetland function when wetlands in the Thief Lake Wildlife Management Area and Agassiz National Wildlife Refuge reduced flood peaks in Crookston and Grand Forks by 1.5 and 0.5 feet, respectively, during the flood of 1979.

The inconsistencies in governmental programs and documented needs to avoid further degradation and destruction of wetlands led to an abrupt turnabout of Federal policy on wetlands, starting with passage of the Federal Water Pollution Control Act Amendments in 1972. A new role in wetland maintenance was established—that of regulator of wetland developments. Permit requirements under the U.S. Army Corps of Engineers' regulatory authority of Section 404 of the act now extend to all waters encompassed by Federal jurisdiction. Regulations to implement the national permit system established shared responsibility among state and Federal authorities. A somewhat similar Federal-state team approach to maintain wetlands is established in the Rivers and Harbors Act of 1899 (Section 10), Coastal Zone Management Act, Fishery Conservation and Management Act, Fish and Wildlife Coordination Act, Endangered Species Act, other statutes, and presidential executive orders that strengthen protection of wetlands and improve floodplain management. Overall, these laws and directives turned Federal policy to maintenance and management of aquatic areas. All Federal agencies now are required to protect wetlands and floodplains to the greatest extent possible from damage and destruction due to Federal, Federally assisted or Federally approved actions and projects.

After more than a century of inadequate attention to and mistreatment of wetlands and floodplains, the Federal government is attempting to eliminate conflicting policies and actions that influence these unique features of the landscape. The objective in this Federal management effort is preventive—to avoid inappropriate development in these valuable areas. This enlightened attitude toward wetlands and floodplains provides the basis for assisting in the realignment and further strengthening of state and local authorities, policies and procedures.

Some states, such as Minnesota, Michigan, Massachusetts, and New York, have adopted relatively new procedures to maintain wetlands. People are looking to Minnesota to learn how landowners accept the new property tax credit system. Despite these important advances, much remains to be done to maintain and manage wetlands, floodplains and the coastal zone more effectively. To register accomplishments will require continuous efforts to realign attitudes, statutes, policies and guidelines. That needed effort is buttressed by Wisconsin and New York court cases. The Wisconsin case sustained a county wetland regulation and found that a landowner has no absolute and unlimited right to change the essential natural character of his land and use it for a purpose for which it was unsuited in its natural state and which injures the rights of others. The New York State Supreme Court held that the preservation of freshwater wetlands has to have broader protections because the substance of the resource transcends local boundaries.

The pressing immediate need for the 1980s in most states is to have decision makers, resource administrators and managers cognizant of all values associated with wetlands, and then align programs to advance their maintenance through the public trust doctrine of law. To delay or fail to act is to consent by default to sacrifices of living resources.



One of the objectives of the Clean Water Act is to make the surface waters "fishable and swimmable" in the 1980s.

SOILS

Rates of soil erosion and associated sedimentation and degradation of public waters have reached alarming status. Food, cover and other conditions required by living resources are limiting fish and wildlife populations in these degrading situations. Our capital resource—topsoil—is being lost at intolerable rates. In the U.S., erosion removes an average of 12 tons of topsoil per acre per year, with losses up to hundreds of tons in some situations, including the midwest and southeast. Soil scientists recommend that annual topsoil losses not exceed five tons on deep soils and one ton on shallow soils to maintain U.S. productivity. Current

soil erosion is a national disgrace. The equivalent of three million acres a year, or about 1 percent of the land under cultivation, is being lost to accelerated erosion. This is in addition to another three million acres being converted to other uses, primarily urbanization. Currently, nearly three out of every five acres, or almost two-thirds, of U.S. farmland needs repair through conservation practices of one type or another.

Curbing soil losses, strengthening water quality management, and preventing loss of prime agricultural lands to nonfood and fiber producing uses are anticipated to receive greater attention in this decade. Among the approaches to improve land stewardship is conservation or minimum or no tillage. Application of this practice increased about thirteenfold (from 4 million to 52 million acres) in the past 15 years (1965–1980), and its energy-saving features may encourage even broader application.

Running counter to this favorable trend in using soils while minimizing losses is the fact that additional land is being lost to erosion as a result of intensive cropping to meet the demand for exports. Sooner or later we must recongize fully that one country's resource base, even that of the U.S., cannot feed the world's human population on a sustained basis. The hope is that the 1980s will see broader understanding of this fact and appropriate adjustment of programs to be consistent with it. We must define what share of the total export need can be added to our U.S. domestic food and fiber requirement without degrading the resource base, as is now being done at alarming rates.

Section 208 of the Clean Water Act calls for resolving erosion and water quality problems through application of best land and water management practices. Pilot projects are in progress. Biologists and resource managers should participate in these trials and seek full implementation of Section 208 to ensure that needs of all living resources are satisfied. One of the objectives of the Clean Water Act is to make the surface waters "fishable and swimmable" in the 1980s. Another important objective must be to perpetuate the productivity of the resource base for fish and wildlife, as well as people, while producing food and fiber.

FORESTS

Forest management plans must be based on resource standards, land allocations and management prescriptions and practices that ensure sustained yields and multiple benefits of resources, including watershed values, timber, forage, fish, wildlife, and recreation. Recent policies and laws, including the National Forest Management Act of 1976, require that the U.S. Forest Service inventory resources and develop a comprehensive plan for all national forests.

Planning for multiple resource uses on each national forest will be integrated into a single document, the forest man-

Forest management plans must be based on resource standards, land allocation and management prescriptions and practices that ensure sustained yields and multiple benefits of resources, including watershed values, timber, forage, fish, wildlife and recreation.

agement plan. Such plans are to be completed for all 154 national forests by 1983–1985, and they will determine the character and uses of the forest for years to come. This is where opportunities exist to design management policies to prevent inappropriate-sized clear cuts, to align roads sensitively, to ensure that water quality objectives are met, to assure patterns of timber harvest and rotational lengths that perpetuate populations of living organisms, and to avoid lengthy legal debates.

Federal and state forest management plans will determine characteristics of future vegetative stands. How will size of forested tracts, mixes of tree species, age of stands, and length of rotations—where timber cutting is practiced—impact the quantity and quality of water resources and population of living organisms? Which wildlife species will benefit? Which species will not? For how long? What management practices should be realigned to prevent adverse impacts to designated fish and wildlife populations?

Incorporating the needs of wildlife species and populations into forest management plans dictates that the stream of new information from research and management experiences be applied. For example, recent studies show that neotropical migrant and forest-interior breeding birds in eastern and northcentral forests are dependent upon extensive forest systems. They have been retreating and will continue to disappear from the landscape in the face of fragmentation of forest areas. Sharp declines have occurred in breeding populations of flycatchers, vireos, warblers and other long-distance migrants.

Best available management planning should be incorporated to perpetuate conditions required for reproduction and feeding by these ecologically sensitive species. To cover all wildlife species in a forest, planners and decision makers must designate featured species or groups of species, and then perpetuate the habitats that support them. This requires intensive planning and management. Planners and decision makers must be prepared to demonstrate which species populations benefit and how, as well as which are disadvantaged and why. Such statements should be designed to improve public understanding of proposed actions, and to justify them.

WILDLIFE

Management and utilization of wildlife populations must continue to be based upon sound conservation principles, the best available biological and ecological information, and public participation in decision making.

As human activities affecting wildlife expand and intensify, demands continue to increase for more scientific information on wildlife habitats and populations. Court reviews enlarge those demands.

Companies planning to build energy or other industrial facilities need basic information on sites required for reproduction and survival of living resources, in order to select the environmentally least damaging and acceptable locations for proposed installations. Such information is required to avoid debates and delays associated with prolonged legal and political battles. Both the Office of Coastal Zone Management and the U.S. Fish and Wildlife Service, in conjunction with state fish and wildlife agencies and others, have prepared a coastal atlas and report for the Atlantic seaboard from the Canadian border to the Florida Keys. Locations of areas of special environmental concern

As human activities affecting wildlife expand, so do demands for more scientific information on habitats and population.

for living resources, such as oyster beds, nursery grounds for finfish, and feeding areas for migratory birds, are identified and rated according to their importance and sensitivity. Simultaneously, areas are ranked for their relative suitability, in environmental terms, for man-made developments. The resulting maps are anticipated to be of tremendous value in guiding developments and maintaining fish and wildlife values. A similar up-front use of scientific information to minimize confrontations involves the model approach being refined at Johns Hopkins University. It holds promise for siting power plants while avoiding and minimizing adverse impacts on living resources.

With strong practical scientific participation by biologists and resource managers, projects could be designed, in some cases, to provide benefits for living resources.

With pending energy developments receiving greater support in Congress, more site-specific information on living resources will be required in more areas to avoid adverse impacts and to expedite sensitive energy developments.

INTENSIVE MANAGEMENT

Regulations must be adjusted to maintain wildlife and fish populations and, when appropriate, make them available for harvest as a part of a total management program. Agency regulatory actions likely will continue to be challenged by those holding anti-hunting, anti-trapping, anti-fishing and other anti-management views. Recent challenges to hunting doves in South Dakota and trapping animals in Ohio and Oregon emphasize that the debates are real. The best offense and defense is to base population management proposals on the best scientific facts available, and to carry out strong wildlife and resource education programs, including hunter or outdoor education.

A general challenge for the 1980s is to maintain private lands open for public recreation. Several national conserva-

tion and agricultural groups have developed a new model state act, plus supporting documentation, to remove the liability of landowners who permit free or fee outdoor recreation on their lands and to convert trespass from a criminal to a civil offense. That model act was approved by the Council of State Governments and is in its 1980 handbook of suggested state legislation released in January. Governors, state attorneys general and state legislators have received copies of the handbook. Fifty-eight cooperating national organizations have distributed the model act to every state and territory and have invited prompt action in each. Existing legal authorities on access-liability-trespass should be examined, current problems identified and the model act evaluated. Evaluators need to determine if some or all of the proposed wording can strengthen the existing legal fabric, help resolve problems and ensure that outdoor recreational opportunities are available on private lands.

With the human population continuing to increase and with people making greater demands on the resource base, the challenges to maintain and enhance fish and wildlife populations also grow. The obvious answer is more intensive resource management. Our immediate task is to obtain the funds and develop the response capability to register accomplishments in the field. Our efforts should focus on four basic tenets:

- To have wildlife and fish, there must be habitat.
- To have recreational opportunities, including hunting and fishing, there must be adequate supplies of wildlife and fish.
- To enjoy fish and wildlife, there must be access to private and public lands.
- To harvest fish and wildlife, there must be public acceptance. ■

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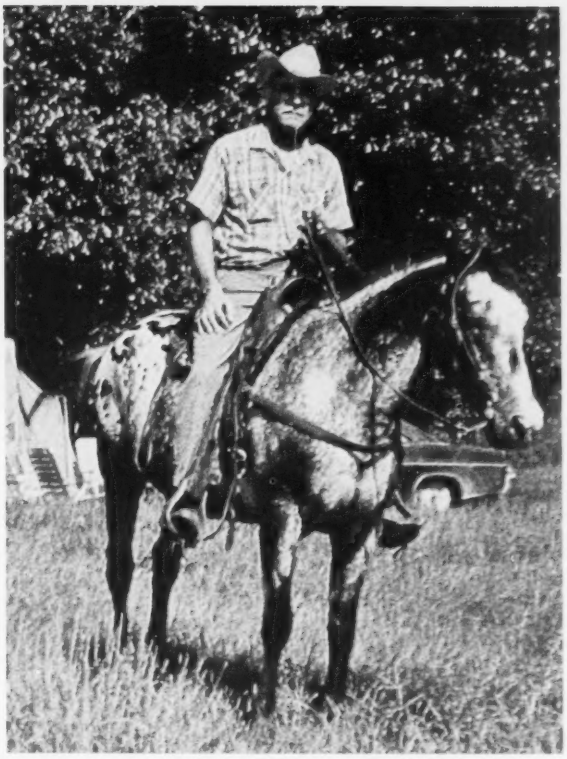
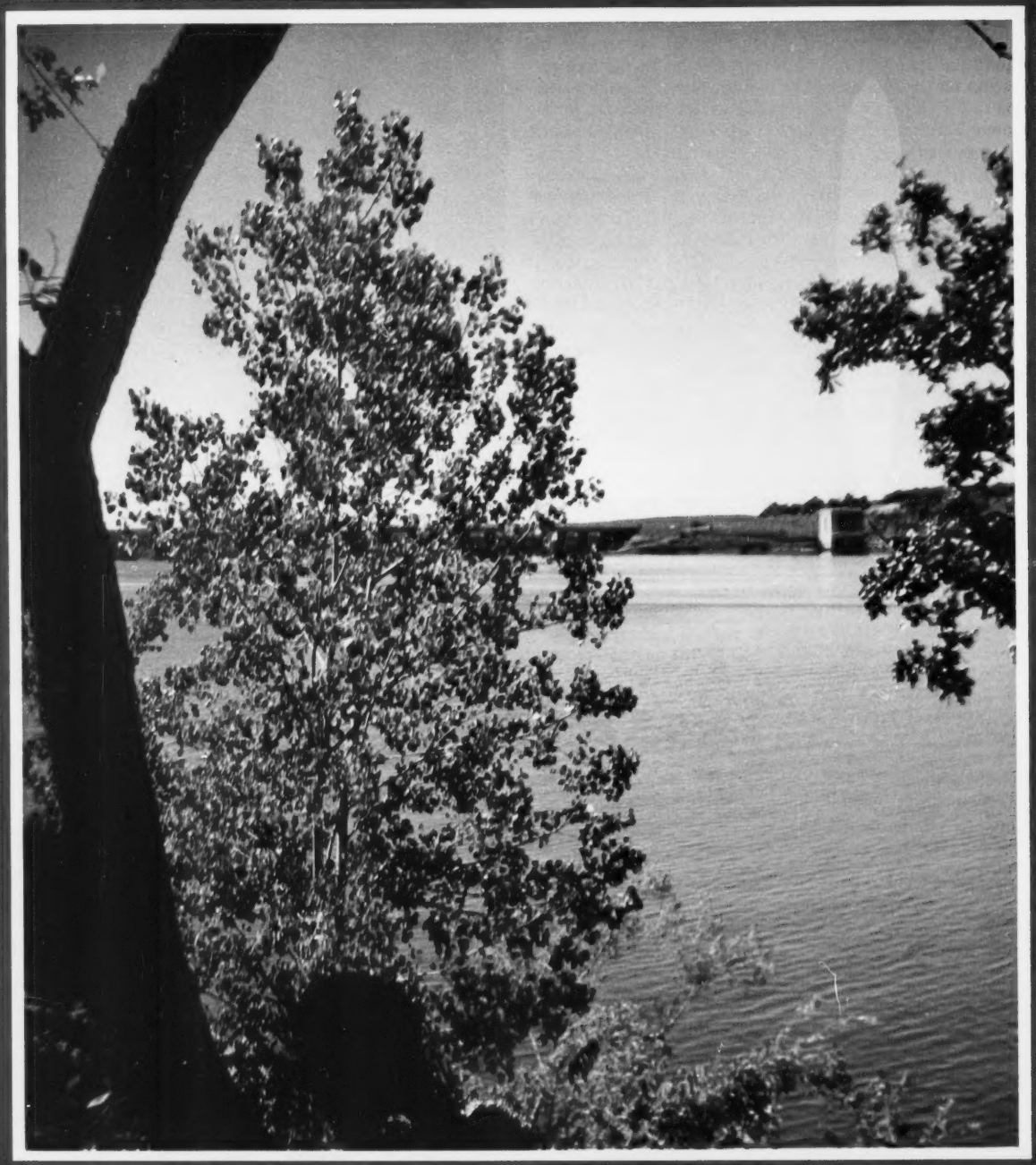


A general challenge for the 1980s is to maintain private lands open for public recreation.

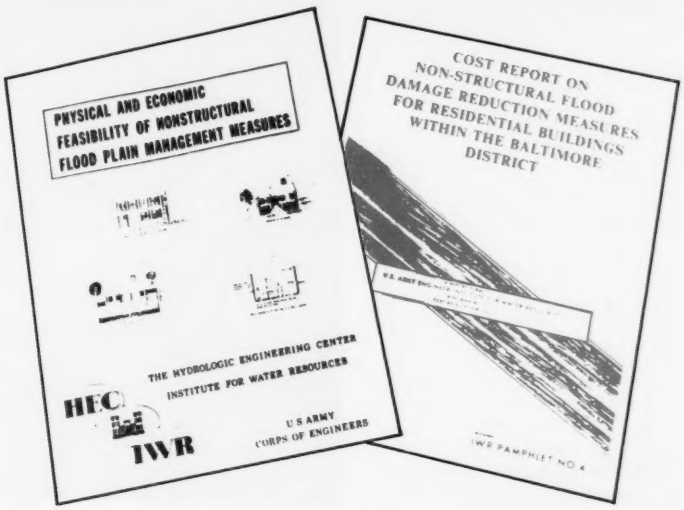
Hunter education should be part of a total wildlife management program.



The Corps of Engineers is a major steward of the nation's water resources.

PEOPLE AND WATER:

Social Impact Assessment Research



Nonstructural design is one of the alternatives that engineer managers have been asked to develop.
(Corps of Engineers photos.)

by Jerry Delli Priscoli

Traditionally, much of Federal water resources engineering has consisted of structural intervention into the natural system to minimize potential stress on the social system and to create new growth opportunities. During the last decade, engineer managers have been asked to develop alternatives that include direct mangement of the social system—water-demand management and nonstructural design, for example.

Actually, we know little of whether managing the social system or natural system is more efficient to deliver benefits, to create growth opportunities and to reduce potential social stress.

Finding a practical balance point is difficult. "New start" opportunities are sparse. Americans are seeking a new balance among environmental preservation and economic development values that is neither a return to some traditional image of a developmental ethic nor a creation of some modern image of an absolute environmental ethic.

In short, such internal organizational and external social trends indicate a changing relationship among public values and bureaucratic norms that asks much. Requirements to minimize project stoppage costs and to estimate public acceptability and implementation costs expand the manager's responsibility beyond traditional engineering and financial feasibility. Today's manager requires early information about public values, in-depth descriptions of how project alternatives affect different social classes, practical skills to forge lasting up-front cost-sharing coalitions and conflict management skills to mitigate adverse impacts.

While often viewed as problems, these trends and requirements can be seen as opportunities to discover new missions, new constituencies and new engineering approaches and service. Social scientists from disciplines such as political science, sociology, anthropology, psychology and economics are assisting Corps engineer managers to define such new opportunities and balance points between natural system and social system management approaches.

Historically, civil engineers, trusted with the keys of technology, have been leading instruments in the process of social adaptation and growth. They have been critical to what Jacob Brownowski, in *The Ascent of Man*, calls man's essential nature, ". . . the explorer of nature . . . the ubiquitous animal who did not find but has made his home in every continent." The civil engineer has recently been dubbed purveyor of old technology, slave to technology fix, or solution seeking application. To the degree civil engineers act according to this image, they relegate their profession to one of limit definers rather than opportunity creators and draw us to a future of deterministic entropy rather than one of evolutionary and visionary growth. As Samuel Florman notes in *The Existential Pleasures of Engineering*, such a view denies the profession its creative and artistic historical roots. He says, "Analysis, rationality, materialism and practical creativity do not preclude emotional fulfillment. They are pathways to such fulfillment. They do not 'reduce' experience, as is so often claimed; they expand it. Engineering is superficial only to those who view it superficially. At the heart of engineering lies existential joy."

Social scientists are assisting the civil engineers in defining opportunities and in creative designing rather than solely negative critiquing. In short, they are helping to rekindle that spirit of civil engineering which Florman describes.

As major water resource engineers, we actively participate in using water resources development to massively affect social behavior and to project

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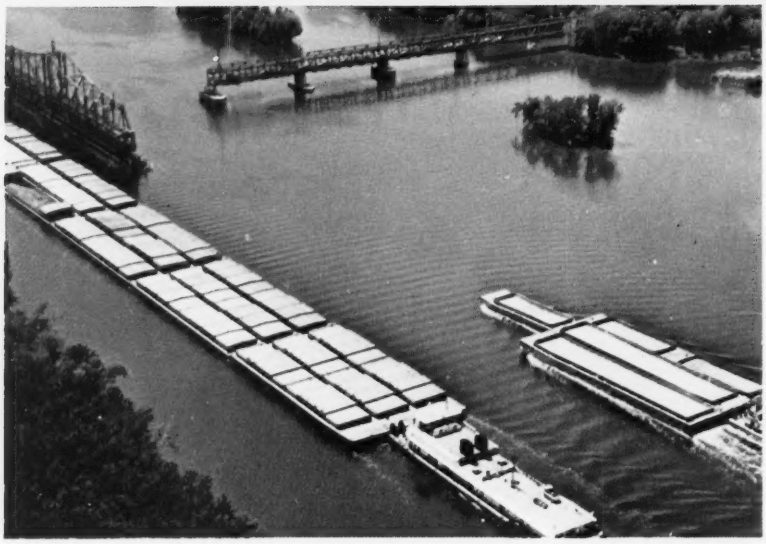


Waterway user charges are one manifestation of the struggle for control over water resources.

how that behavior will affect water resources. Yet we know little of this interaction. Social scientists and economists have long recognized that political-social structure is related in some way to how we organize to supply and distribute water. In fact, water resource development has helped to transform previously blighted sections of the country. Yet we know little of how current development is affecting population and wealth distribution such as that around coastal and arid areas. As responsible decision makers, we make assumptions about how the private sector perceives itself, about the relationship between savings and expectations and the capacity of the individual to assume capital investment. Yet we do little to verify such assumptions as required in new principles and standards-associated national economic development account costs. Major programs cannot be adapted to regional differences such as urban vs. rural and arid vs. wet without some explicit notion of social structure, attitude and opinion differences. Yet the tendency has been to design similar structures across regions.

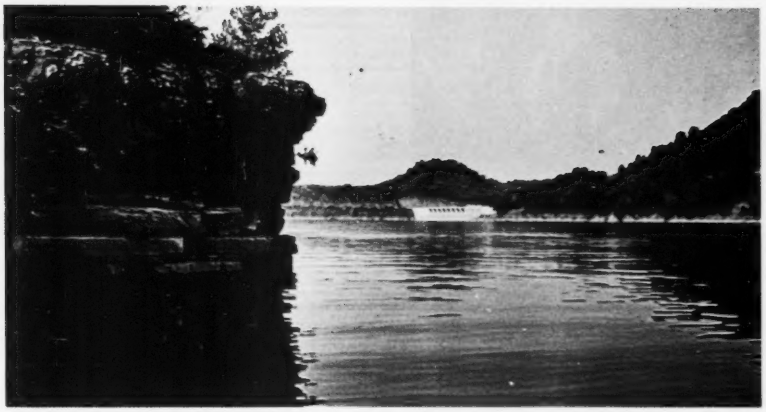
During the 1970s, congressional legislation, executive regulations and changing public values required the water resources manager to deal explicitly with broadened "chunks" of social reality. As we enter the 1980s, management efficiency and state participation are likely to accentuate this trend.

The time has come to rethink the tools by which we determine how our vast engineering resources are distributed throughout society.

In the past, we looked primarily to a blend of the benefit-cost analysis and congressional-local political constituency building. However, a narrow adherence to benefit-cost analysis biases benefit calculations in favor of property-based wealth and can put the government in the position of recommending public expenditure that supports fixed income distribution. Significant constituencies of potential new projects are consequently not mobilized into project support.

Although congressional-executive struggles for control over water resources policy continue, Congress itself is changing. Support for waterway user charges, urban water supply and state roles increases. New information disclosure requirements and new national actors combine to increase those publics seeking involvement in water resources development decisions.

At the executive level, public expenditure will be asked to demonstrate how direct Federal investment, such as Corps projects, encourages private and other economic activity. Some states seek more technical assistance programs from the Corps. As projects require more "up front" cost sharing, there will be a great need for coalition building skills to solidify project support. Effective flood control, in minimizing potential social stress, has come to mean mixed structural and nonstructural strategies that demand both new information and analytical techniques to evaluate social behavior. We are rediscovering that controlling a river is as much a social as a technical problem. Determining development needs in urban versus rural areas, east versus west, will be manifested more explicitly as inter-regional conflict over water funds grows. How the nation decides what to operate, maintain, build or close is becoming a more explicit question of social equity. To the degree water and its uses become more visible to a broadened spectrum of society, the Corps will also inherit a new visibility. As a major steward of this nation's water resources, the Corps, if only through reactive policy, will increasingly be perceived as a force in defining who benefits from, and who is denied access to, this national engineering expertise. Much of the demand for expanded social description stems from a discontinuity between what is projected and what happens. The social scientist brings tools to engineering that probe more deeply into how people perceive engineering actions, that describe the sequencing and accruing of costs and benefits, and that estimate relative deprivation spawned by such actions.



Controlling a river is as much a social as a technical problem.

Beyond these conceptual appeals, the Corps has traditionally been subject to numerous legislative and regulatory requirements for social impact assessment. Since the 1936 Flood Control Act, with its mandate to find ". . . benefits to whomsoever they accrue. . . ." the Corps has been in the social assessment game. Born of this requirement, but not broadly used until decades later, benefit-cost analysis was the major technical tool to describe how civil engineering was applied across society. The degree to which this technical economic tool has both affected engineering design and become a normative standard in the decision to recommend projects is unclear. As the result of a historical drive to develop national water policy, and an emergent need to recognize broader environmental, social and economic values, Congress passed legislation such as the National Environmental Policy Act and Section 122 of the 1970 Flood Control Act calling for broader evaluations of the costs and benefits of engineering actions.

From the late sixties through the seventies, the President's principles and standards for water resources planners also recognized this need for broader social accounting in water resources project planning. While much debate has surrounded the four objectives versus two objectives and four accounts, a social well being, and now other social effects, account has remained. Traditionally, economic effects have been classified as tangible (direct or indirect) and intangible. Today debate continues over whether other social effects are tangible indirect economic and national economic development effects or intangible environmental quality effects. Substantial arguments supporting both positions can be cited.

Many economists often feel that the other social effects account is essentially economic and that economic practice within the Corps needs only fine tuning to meet other social effects requirements. Many environmentalists, citing the wording of the National Environmental Policy Act, a link to public health and the quality of life concept, see other social effects as somehow different from economics. Both the economist and environmentalist often desire to claim the benefits of the other social effects account and relegate its costs to the other. To some degree, we are witnessing the limitations of disciplinary divisions in applied policy circumstances and a fundamental shift in the conception of planning.

Historically, the movement from single purpose, single means to multipurpose, multi-means project justification has logically also demanded broader social accounting. Multiobjective projects can claim distributed beneficiaries across geographical and social class boundaries. Against the benefit picture, we often find intensively held locally concentrated perceived risk and cost, frequently supported by national special environmental and other interests. Our public agencies have yet to strike a good operational balance between alignment of national special interest, the localized community feeling and the claimed benefits.

The trends to broaden social science description and to include new disciplines such as anthropology, history, sociology and political science, are reaping positive benefits.

Frequently, social impact work, which has flourished under the National Environmental Policy Act, inherited an image of negative assessment, project delay, or bearer of bad news. Those days are passing. The new disciplines bring to the organization rudimentary tools that help managers to understand their external environments, to cope with internal resource constraints and to manage uncertainty. Through its social impact assessment research, the Institute for Water Resources (IWR), a division of the Water Resources Support Center, has identified 12 generic tools whose applications have, among others, the following payoffs for Corps management:

Public meeting.

- To increase efficient expenditure of resources by estimating implementation outlay costs.
- To improve our ability to project acceptability of alternatives.
- To identify new missions and constituency opportunities early
- To assist our ability to forge early and strong cost-sharing conditions.
- To reduce the number, but make more representative, alternatives considered in planning.
- To enhance our ability to project conditions both with and without the project.
- To fill out the other social effects accounts.
- To project construction phase impact and mitigation.
- To define new human and non-property based flood damages for the national economic development benefits account.
- To better project unemployed national economic development benefits.
- To provide innovative and practical means for constructive public involvement.
- To assist the evaluation process within environmental quality accounts.

In the fall of 1976, the Institute for Water Resources hosted a conference of Corps social scientists in Memphis. About 125 participants discussed the application of new social science analysis techniques to the Corps. Virtually every district and division office was represented, as were the Office of the Chief of Engineers, the Board of Engineers for Rivers and Harbors, and several Corps laboratories. The published conference proceedings have met favorable reaction outside the Corps and in academia.

A number of academicians have commented on the blend of theory and practicality employed by Corps social scientists.

The Corps has attracted a group of very capable young social scientists and stands on the threshold of significant breakthroughs in applying innovation in economic and other social science theories to water resources planning and management.

In the last three years, the Institute for Water Resources has maintained a modest 1-2 man-year research effort in applying social science to Corps field problems. This research has evolved closely with Corps field district needs through cooperation on a

Public expenditure will be asked to demonstrate how direct Federal investment, such as Corps projects, encourages private and other economic activity.

APPLIED SOCIAL SCIENCE PROGRAM OVERVIEW

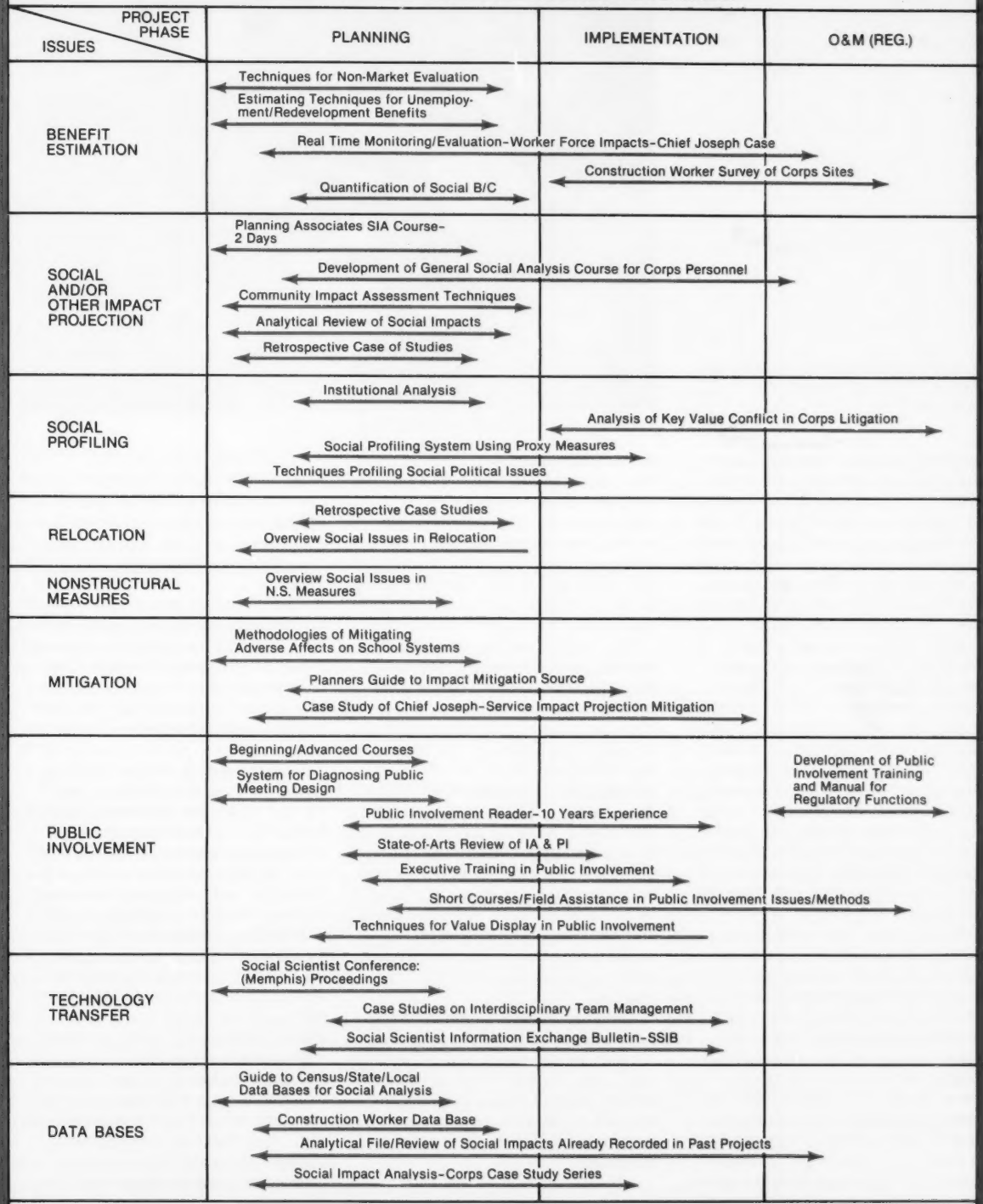

PROJECT PHASE
ISSUES
PLANNING
IMPLEMENTATION
O&M (REG.)
BENEFIT ESTIMATION
Techniques for Non-Market Evaluation
Estimating Techniques for Unemployment/Redevelopment Benefits
Real Time Monitoring/Evaluation-Worker Force Impacts-Chief Joseph Case
Construction Worker Survey of Corps Sites
Quantification of Social B/C
SOCIAL AND/OR OTHER IMPACT PROJECTION
Planning Associates SIA Course-2 Days
Development of General Social Analysis Course for Corps Personnel
Community Impact Assessment Techniques
Analytical Review of Social Impacts
Retrospective Case of Studies
SOCIAL PROFILING
Institutional Analysis
Analysis of Key Value Conflict in Corps Litigation
Social Profiling System Using Proxy Measures
Techniques Profiling Social Political Issues
RELOCATION
Retrospective Case Studies
Overview Social Issues in Relocation
NONSTRUCTURAL MEASURES
Overview Social Issues in N.S. Measures
MITIGATION
Methodologies of Mitigating Adverse Affects on School Systems
Planners Guide to Impact Mitigation Source
Case Study of Chief Joseph-Service Impact Projection Mitigation
PUBLIC INVOLVEMENT
Beginning/Advanced Courses
System for Diagnosing Public Meeting Design
Development of Public Involvement Training and Manual for Regulatory Functions
Public Involvement Reader-10 Years Experience
State-of-Arts Review of IA & PI
Executive Training in Public Involvement
Short Courses/Field Assistance in Public Involvement Issues/Methods
Techniques for Value Display in Public Involvement
TECHNOLOGY TRANSFER
Social Scientist Conference: (Memphis) Proceedings
Case Studies on Interdisciplinary Team Management
Social Scientist Information Exchange Bulletin-SSIB
DATA BASES
Guide to Census/State/Local Data Bases for Social Analysis
Construction Worker Data Base
Analytical File/Review of Social Impacts Already Recorded in Past Projects
Social Impact Analysis-Corps Case Study Series

Chart 1. Research outputs and how they relate to generic water resources development problems (vertical axis) and across Corps functions (horizontal axis). Specific research outputs are identified within the matrix cells. Those above arrows are applicable beyond planning to other Corps functions. The program has produced five types of research outputs: case studies, data bases, analytical techniques, learning modules for training, and bibliographic guides and reviews.

Small group techniques engage expert scientists in designing research programs.

range of planning, implementation and operation problems. In several cases, the institute and field districts have jointly completed research and development. A training program in state-of-the-art applied social science techniques has built an impressive track record in serving field needs of Corps personnel from planner to district engineer. Special seminars in social impact analysis techniques, specifically tailored to individual districts, have been held in districts requesting such assistance. The social impact assessment program at the Water Resources Support Center is pioneering both new paths to apply techniques and new ways to transfer that technology among field districts. While this research has focused primarily on planning, its results apply across implementation and operation functions of the Corps.

Benefit estimation work has reviewed non-market evaluation techniques; developed techniques to estimate redevelopment benefits of previously unemployed labor; and developed new approaches to the quantification of psychological and trauma impacts of flooding. The Water Resources Support Center's direct impact assessment work has ranged from a review of past cases, to current case studies, to the development of techniques for community service impact assessment. These efforts have provided a basis for applied social analyses training courses for Corps executives as well as field planners. Case studies on social impact mitigation have paralleled the impact assessment work and have now produced both an illustrative case study and a field planner's guide to social impact and Federal mitigation sources.

The research on relocation and nonstructural alternatives has been limited to retrospective case studies and conceptual overviews of social issues associated with relocation and nonstructural measures. Social profiling techniques, often viewed as a bibliographic regurgitation of census data, have been developed into more meaningful planning tools. The Water Resources Support Center has produced case studies that illustrate how social profiling can be accomplished by utilizing less data more effectively and has produced manuals on techniques to profile the political environment to complete an institutional analysis.

The link between public involvement and social impact assessment remains operationally unclear within the Corps. Outputs from the social impact research program have contributed to the already existing substantial public involvement training programs.

Most importantly, the research program has reviewed techniques for identifying, displaying and evaluating values in public workshops.

A state-of-the-art review of how public involvement and social impact analysis relate has been completed, as has a new values design learning module. Conflict management and mediation are two further techniques that cross both social science and public involvement programs.

Since funding is modest, the program has focused on finding, enriching and expanding innovative district field cases. Technology transfer is consequently at the heart of these efforts. Beyond the social science conference, a social science information exchange bulletin is published quarterly and a continually updated file of roughly 1000 Corps personnel attending training courses is maintained. As techniques become more refined and packaged, we intend to use more audiovisual tapes.

Data bases are generally unexciting. However, we have "on line" a construction worker data base covering 55 Corps projects which is compatible with other water resource agency surveys. This data base can assist planners to generate initial estimates of construction related impacts and to estimate unemployment benefits and worker location preferences. Various other guides to census materials have also been generated.

"Now in this scene I want you all to break into small discussion groups." (J. Ragan, Associates.)

Out of these studies, guides, revisions and training, we have identified social science tools, some new and some old, which the planner can add to his kit.

The social impact research program has identified the following 12 classes of old and new social science tools whose applications are reaping rudimentary success in various Corps districts:

- Social profiling
- Content analysis
- Community impact assessment
- Institutional analysis
- Small group processes techniques
- Human cost accounting
- Policy profiling
- Population projections
- Ethnographic and field analysis
- Questionnaire non-parametric statistical analysis
- Value mapping
- Trend and cross impact analysis

This characterization has emerged from interaction among researchers and field planners and currently forms the heart of the social impact assessment training course. Special learning modules have been developed for some of these techniques, while others are explained in standard research reports. Program goals are to develop learning modules that describe basic principles for each of these so they can be distributed throughout the Corps in audiovisual or traditional report formats.

Taken together, institutional analysis, policy profiling and value analysis offer alternative means to a questionnaire approach for assessing social acceptability of alternatives.

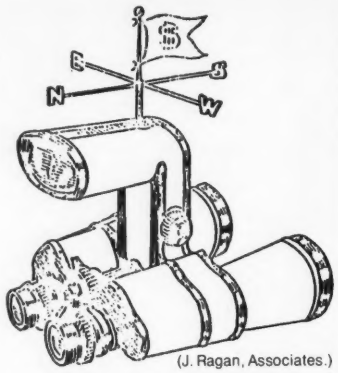
The Water Resources Support Center's institutional analysis manual presents a 10-step process that moves from describing existing study organizational environment through fiscal analysis to processes for assessing current and potential future institutional arrangements.

The procedure can yield estimates of implementation outlay costs, basic data for cost-sharing arrangements and information on what special institutional agreements are necessary for each alternative.

Policy profiling is a technique for assessing the impact of various individuals, groups and organizations on decisions that affect the Corps. As the policy profiling learning package shows, it is most useful in situations where a small group of professionals must either reach a decision or assess the impacts of decisions on an external political-social environment. Based upon common sense and political science principles, the technique simply guides individuals through a systematic thought process, records their perceptions at crucial steps in the process and produces a net political assessment number that reflects the group's subjective judgment of feasibility of actions. Among other things, it has provided a quick means to "red-flag" controversial permit decisions from among several potential decisions.

Value analysis is a generic category for numerous techniques covering value identification, display and trade-off analysis. To date the Water Resources Support Center has produced background reviews of techniques and developed a learning exercise on how to map values in a study area and use this information to focus on fewer, but more representative, alternatives. Improved techniques in this area hold the keys to understanding relative deprivation perceived by those impacted by Corps projects, to facilitating constructive alternative trade-offs, and consequently to increasing planning efficiency by focusing resources on items of high probable acceptance.

Since Section 122 requirements, social profiling has been the most visible role for the district social scientists. IWR, at the Water Re-



(J. Ragan, Associates.)

"This instrument provides powerful lenses for peering into the future, a reverse prism for hindsight, and a weather vane to show which way the wind is blowing."

sources Support Center, has sought to package ways to move beyond traditional census data "dumps" and focus more clearly the social data gathered. A technique manual presenting various alternatives is now planned and a few case study examples of profiling techniques are available.

One of the best information sources on the external political and social environment comes to a Corps district in the form of letters, public comment and news media.

Since this information is not packaged in ways readily compatible to Corps planners, much of it is not fully utilized. The content analysis technique package describes how the Corps district can routinely and cheaply capture this data over time through a simple version of content analysis. Administrative and secretarial professionals can do the simple basic coding, which produces machine-readable outputs.

Much of the information needed for social assessment is not readily available in standard statistical formats. A great deal of it must be generated by the Corps primarily through various forms of public workshops. Small group techniques include active listening skills, communication skills, and other group process skills. They offer alternatives to questionnaires for generating value, opinion and attitude data. Descriptions of how to use these techniques, including some pioneered by the Corps, are contained in the Water Resources Support Center's recent 10-year public involvement compendium.

From the drive to quantify social effects, a new category of human cost accounting has emerged. Based on the idea that property-based values tell only a partial damage prevention story, the Water Resources Support Center has pioneered two new roots to human cost accounting: quantifying psychological trauma damages prevented and behavioral damages prevented. In the first case, victims of flooding are analytically placed on a value trauma scale and trauma effects are related to American Medical Association levels of impairment. Degrees of impairment are translated into dollars paid by the Veterans Administration for comparable disabilities. In the second case, descriptions of behavior are examined through questionnaires and that behavior is translated into economic disruption costs. Currently, a general methodology is being produced and a program begun to further test these techniques on small flood control projects that previously appeared economically marginal. One case study now completed shows greatly increasd benefits beyond property values in communities with low home values.

Community impact assessment has evolved as a clearly defined subset of more general impact assessment areas. It focuses on the influx of construction workers before, during and after peak construction. The planner estimates the construction worker phasing, translates that into population increase in local communities, and estimates whether this influx will exceed the capacity of basic community services. Since estimates depend upon a number of subjective locational preferences and sub-county population statistics, the Water Resources Support Center has developed a data base built on a survey of construction workers at over 50 Corps sites. This data base, together with a before, during and after case study and a community impact assessment process guide, provide a technique guide for planners to make initial estimates and to manage the fear of the boom-bust syndrome. Most recently, these techniques have begun to be effectively applied to potential MX missile construction.

PLANNING PROCESS / TECHNIQUES	SPECIFY PROBLEMS	INVENTORY CONDITIONS	FORMULATE ALTERNATIVES	EVALUATE		COMPARE PLANS	SELECTION
				ASSESS	APPRAISE		
SOCIAL PROFILING	✓	✓					
CONTENT ANALYSIS	✓	✓			✓		
COMMUNITY IMPACT ASSESSMENT		✓		✓	✓		
INSTITUTIONAL ANALYSIS		✓			✓	✓	✓
SMALL GROUP PROCESSES	✓		✓	✓	✓	✓	
HUMAN COST ACCOUNT	✓	✓		✓			
POLICY PROFILING			✓			✓	✓
POPULATION PROJECTION		✓					
FIELD ANALYSIS		✓		✓			
QUESTIONNAIRE AND NON-PARAMETRIC	✓	✓				✓	
VALUES ANALYSIS			✓	✓	✓	✓	✓
TREND AND CROSS IMPACT				✓		✓	

Chart 2. Planning process areas where social science techniques can be most effective. Techniques are listed on the vertical axis; on the horizontal axis are planning process areas as described in the Water Resource Council principles and standards. Decisions to use any tool or technique depend upon manpower, resources, and the overall stage of planning. This chart suggests some primary ways to link tools to required planning.

An old social science technique and one frequently useful to the Corps is ethnographic field analysis: a planner "walks the study area." Participant observation can sometimes locate seemingly little items that can translate into larger project stoppages. These techniques are essentially sensing mechanisms to provide "early warning" of the social environment. While it is difficult to train people in certain sensitivity techniques and while engineers are often uncomfortable with the validity of data provided, case study examples can be shared and general principles described. We have developed a simple short guide to principles of these techniques as applied to the Corps.

Questionnaires are the most frequently overused of social science techniques. Since questionnaire data is a snapshot, it provides a good comparative static picture. There are Office of Management and Budget limitations, financial and resources skill limitations to their use in the Corps. IWR has a brief overview package of this applicability to the Corps.

Frequently data from questionnaires and other sources are of a nominal or ordinal level. This is often uncomfortable to the engineer, who often deals with interval level statistics such as regression analysis. The social scientist brings to the engineer less familiar statistics such as contingency table inferences more appropriate to social values data. Broader applications of such techniques awaits new policy guidance on other social effects display techniques. As with questionnaires, the institute has prepared a brief overview of the possibilities of such non-parametric statistics.

For the most part, the Corps planner starts with Federal population projections. However, in special regions or in cases of sub-regional data needs, the planners may adjust these projections. The social scientist can bring the planner a basic knowledge of the principal components of population projections.

Although projections appear objective, they are assumption based and value driven.

The social scientist is familiar with techniques which may assist planners, themselves included, to clarify assumptions and value bases.

Trend and cross impact techniques are useful tools to help planners make future projections. We have provided computer assisted packages to use these techniques in planning.

Social scientists, especially economists, have been with the Corps for several years. While many of the tools emphasized in the Water Resources Support Center's Social Impact Assessment Research Program have long been available, their applicability to the Corps has become more relevant in the last decade. This decade of water resources development has required broadened social evaluation and thus social scientists from disciplines beyond economics and using new applications of these tools. Together with Corps economists, these new social scientists are making positive contributions. The program attempts to capture these contributions, enhance their validity and transfer their application throughout the Corps. ■

Grass-Roots Water Quality Protection

by John E. Gannon and Marion Secrest Gold

Inland lakes are immensely appreciated, but often threatened. Along with their recreational and economic benefits come environmental questions and problems for the states, counties and townships in which they are located.

In the late 1970s, an environmental communication research program in northern Michigan addressed the problems of water quality protection in inland lakes. The work was conducted by staff and students at the University of Michigan Biological Station, located 20 miles south of the Straits of Mackinac at the northern tip of Michigan's lower peninsula. The cornerstone of the program was a strong link to the local community (township and county officials and lake property owners). A look at the biological Station's grass-roots environmental communication program may provide insights on similar environmental problems in inland lake districts across the country.

Tourism has provided the major economic base for communities in northern Michigan for many decades. Since the early 1950s, however, steadily increasing numbers of people not only have visited northern Michigan, but also have moved to the area permanently to escape urban crowds and pollution to the south. The surge of growth and development is beginning to have noticeable effect on northern Michigan's environment, especially its inland lakes. These water bodies are the major attraction to the area. Overall water quality is still good in most lakes, but poorly planned development and uncontrolled growth around the lakes and in the nearby countryside can degrade the very resource the people came there to enjoy.

The major source of declining water quality in northern Michigan lakes is cultural eutrophication, lake aging caused by increases in nutrients (stimulants to plant growth such as

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phophorus and nitrogen) and sediments (sand, clay, silt and organic debris) which can be directly related to human development on and near lakeshores. The consequences of advanced eutrophication—turbid waters, weed-choked shores, foul odors, stunted fish populations—are not compatible with most recreational and other lake-oriented pursuits.

Those lakes already showing symptoms of cultural eutrophication may require restoration to a previous condition of better water quality. A variety of lake restoration techniques such as dredging, weed harvesting, oxygenation of bottom waters and nutrient inactivation has been developed in recent years, and there is Federal assistance to offset the high cost of these procedures through the Environmental Protection Agency's Clean Lakes Program. Although some of these techniques show promise in reversing the course of eutrophication in some lakes, it makes more ecological and economic sense to control eutrophication in its early stages through foresighted land use and lake protection measures rather than to implement a restoration program after the fact. Most lake restoration procedures treat the symptoms, not the cause, of cultural eutrophication, so they usually provide only temporary relief. It is better to maintain water quality at a stage when protective measures will suffice.

The problem with implementing lake protection procedures is that lakes still with relatively good water quality do not arouse much public concern. Early changes in water quality are ignored by state management agencies, which must direct their limited manpower and resources to more severe water quality problems elsewhere. Hence, if there is need for a lake protection program, the local community must become involved.

We began research on 40 inland lakes in northern Michigan near the University of Michigan Biological Station. Studies on water quality characteristics evolved into detailed nutrient budget analyses. Household development on unsuitable lakeshore soils (especially inadequate for wastewater treatment of septic system seepage) was identified as the major source of cultural eutrophication in area lakes. No state laws or local ordinances existed to combat the slow, incipient changes in water quality.

Consequently, our limnological research program melded with a grass-roots environmental communication effort. Our basic philosophy was that environmental decisions will not be much affected if reports are simply disseminated. Rather, many mutually reinforcing channels of communication must be employed to develop a climate of understanding for needed decisions.[1]

Our program succeeded in abating eutrophication; specifically, in improving on-site wastewater management, controlling lakeshore population density, promoting lakeshore greenbelts, and protecting lakeshore wetlands. The issue of wetlands protection illustrates the communication strategies and program development employed. The issue is of national significance, and the problem of local acceptance of wetlands management is universal.

Our environmental communication program did not

[1] Pelz, D. C. and J. E. Gannon. 1979. Utilization of environmental knowledge for watershed management in northern Michigan. *Environ. Manag.* 3:113–121.

Algae scums and excessive weed growths, consequences of eutrophication, lessen recreational enjoyment of inland lakes. (Photos by the author.)

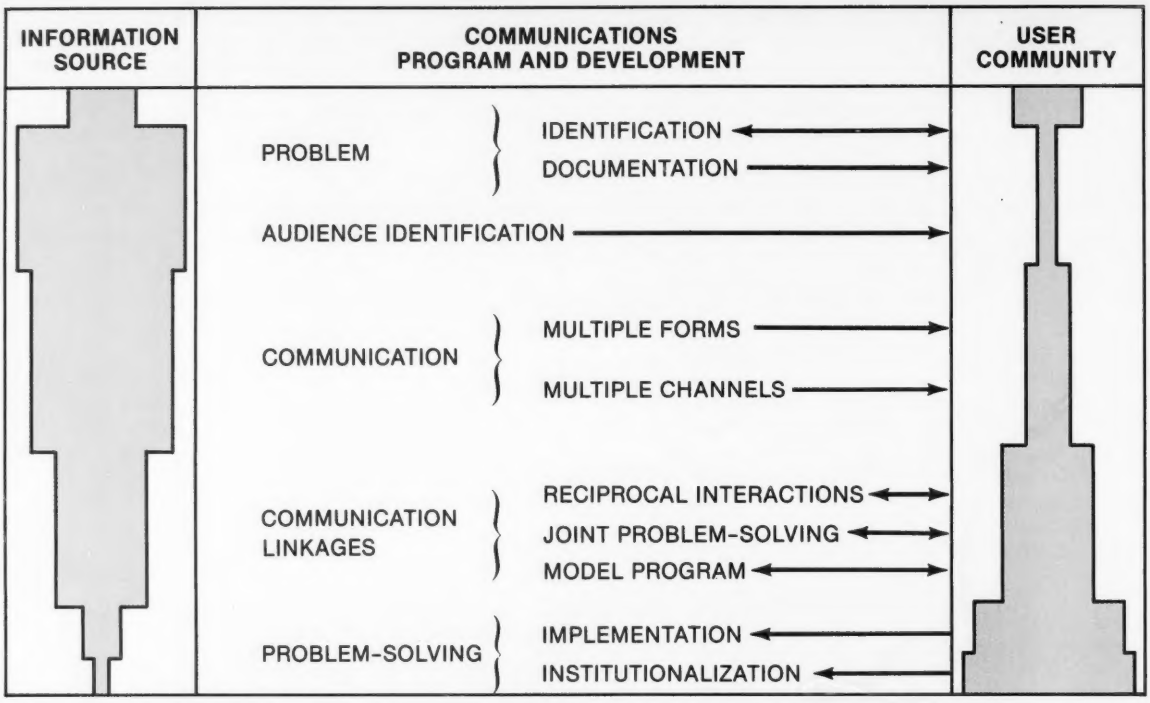


Chart 1 The environmental communication strategy, progressing from identification of the problem to its solution. Two-way communication is essential, but the degree of involvement of the information source and the user community varies as the program develops. The size of the blocks shows the relative degree of involvement of the two groups at each step in the program. The arrows indicate the major direction(s) of information flow.

follow a rigid pre-determined strategy. Rather, it gave particular attention to the public's perception of specific water quality issues and how the issues related to local situations and individual concerns. Regardless of the slight differences between strategies used on specific issues, the development of the communication program followed a definite sequence.

PROBLEM IDENTIFICATION AND DOCUMENTATION

Research conducted on various wetlands types throughout the country has established that protecting shoreline wetlands can help protect lake water quality. Our first step was to provide local documentation of the value of wetlands. That emphasis was based upon the principle that people resist the methods used to put change into effect more than they resist the actual change.[2] The resistance to change can be lessened by involving people in the decision-making process and by ensuring that the community clearly understands the need for change.

When the protection of wetlands was introduced to the northern Michigan community as an environmental problem, information was presenteed on the characteristics and ecological importance of wetlands bordering local lakes. When people saw how the destruction of a particular wetland would damage the water quality of a specific lake, they began to understand the importance of wetlands to their own property. Gradually, they began to perceive protection of wetlands as a local concern and responsibility.

AUDIENCE IDENTIFICATION

Identification of the target audience for an environmental communication program is critical. In our case, it became evident that some of the information (especially printed media) would reach the general public, but the main target audience consisted of two subgroups. Lakeshore residents, those people living on or adjacent to a lakeshore, potentially have the greatest stake and interest in water quality protection. Decision makers—local government officials, resource managers and citizen opinion leaders—are in a position to influence or establish long-term lake protection programs.

Although the target audience consisted of two subgroups, we did not employ separate and distinct communications strategies. Lakeshore residents and decision makers in the area had a history of infrequent communication. A majority of lakeshore residents were seasonal and had voting rights primarily at their permanent residences elsewhere, whereas decision makers were primarily longtime local residents. By treating the two subgroups as a single audience, we intended to promote interaction, common interest and mutual concern about lake quality protection.

[2] Lippett, G. 1965. Overcoming human resistance to change. pp. 79–100. *In* Kimball, W. J. (ed.) *Community Resource Development.* Proceedings, First National Conference on Community Resource Development, July 12–30, 1965. East Lansing: Michigan State University.

MULTIPLE FORMS AND CHANNELS OF COMMUNICATION

We used a variety of communication methods in the wetlands program. The target audience received regular mailings concerning Biological Station programs; met frequently on a one to one basis with project staff; received two booklets in the Biological Station's *Lakeland Report* series[3] containing ecological information, maps, photographs and alternative management options for local wetlands; participated in a local conference on wetlands management; and toured local wetlands. In addition, slide presentations on wetlands protection were given at meetings of all major lake property owners associations, numerous civic groups and local officials. To build a base of awareness and support for wetlands protection in the population at large, some communication efforts (especially newspaper, radio and television coverage) were directed toward a more general audience.

Communicative techniques used in the water quality protective program (modified after Klessig, L.L. 1979. The Means and Ends of Public Participation, pp. 27-31. *In:* Lake Restoration - Proc. Nat. Conf., 22-24 August 78, Minneapolic, Minn., EPA-440/5-79-001.)

- Advisory committee
- Analysis of mass media
- Analysis of incoming mail
- Day-to-day public contacts
- Contact with key opinion leaders
- Brochures and booklets
- News releases to mass media
- Presentations to groups
- Informational meetings—selected participants
- Mini-conferences
- Workshops
- Field trips

COMMUNICATION LINKAGES

Facilitating communication linkages between the information source (in this case, the Biological Station) and the target audience and between subgroups in the target audience can greatly enhance the resource management program. Citizens, public officials, research scientists and resource managers came together, often for the first time, to discuss wetlands and other matters of water quality protection. The interactions often initiated productive working relationships between individuals and organizations. For example, following the wetlands conference, task forces were organized in the two counties encompassing the program area. The wetlands task forces worked hand in hand with Biological Station staff on all subsequent wetlands activities.

Once communication linkages were established, joint problem-solving and reciprocal interactions characterized the wetlands protection program. Only after a period of time and a great deal of interaction could the user community, a group of non-scientists, have the understanding and technical skills necessary to develop and implement a wetlands management program. Similarily, without working with the local community, the Biological Station staff could not have designed a program that met local needs and capabilities. The two parties had to work through the problem-solving process together, to share information and ideas, and then to use their pool of knowledge to develop feasible wetlands management programs.

It makes good sense that people will be more willing to try something new to them if they see it working successfully somewhere else. Based on this premise, the Biological Station staff sought out existing programs that could be used as workable models for local groups to follow. For example, a township encompassing a large lake downstate had a long history of overdevelopment problems. The voters there passed a township ordinance banning development in local wetlands. The Biological Sation used this example as a model program and introduced it to the local community.

PROBLEM-SOLVING

Actual problem-solving through implementation (establishing a voluntary management program) or institutionalization (adopting a law or ordinance establishing a management program) is the primary responsibility of the community. The information source—the Biological Station staff—at this point in the environmental communication program has little involvement. Local agencies and lake associations implemented and institutionalized many of the lake management alternatives introduced by Biological Station staff.

Wetlands provide wildlife habitat, here an active muskrat hut.

[3] Pelz, D. C. and J. E. Gannon. 1980. Lakeland Reports: A communicative tool in watershed management. *J. Tech. Writing and Comm.* 10:17-24.

Local involvement in wetlands management is now well established. One local township has passed an ordinance restricting wetlands development, using depth to seasonal high groundwater as the basic criterion for delineating wetland areas. Acquisition of a sensitive wetland is underway, based on a model program instituted by a nearby community. A county planning department has undertaken to give wetlands priority by need for and cost of protection. Wetland committees have been established by many area lake associations and other community groups. Citizen efforts are being coordinated through a newly formed watershed council, an umbrella organization of many area lake associations. Resource agencies, especially the Soil Conservation Service and regional planning organizations, are providing long-term technical support for local wetlands protection programs.

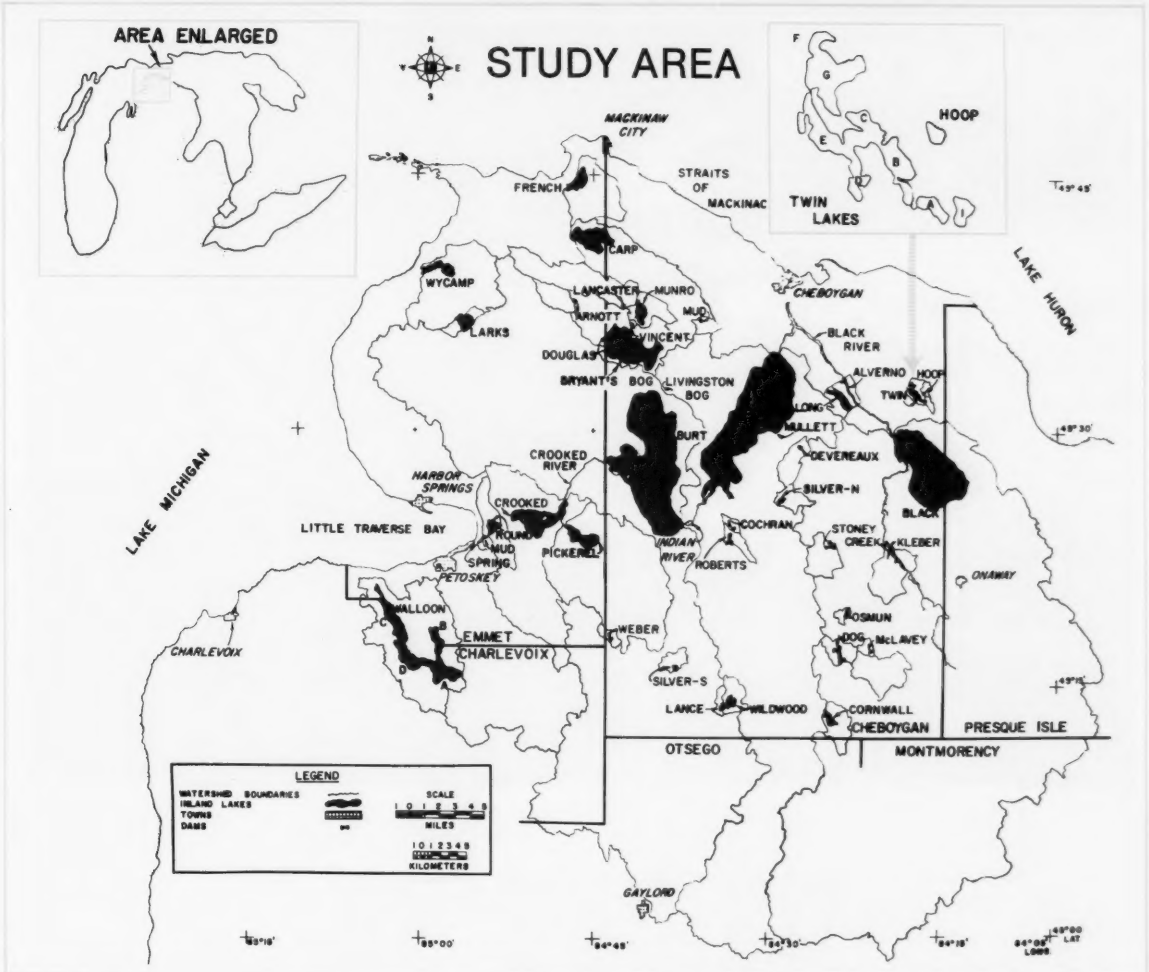
Livingston Bog.

McLavey Lake.

Crooked River.

If lakeshore wetlands are to be preserved, wise management practices must be instituted to relieve the pressures of growth and development.

O'Neil Lake.



AMONG THE IMPORTANT INSIGHTS WE GAINED FROM THE PROGRAM ARE:

- No single communication method can be expected to solve environmental problems overnight. However, the graphical model of communication development (*See Chart 1.*) does appear to be applicable in approaching environmental problem-solving elsewhere, especially at the local community level.
- The importance of long-standing rapport with the community and a commitment to understanding local attitudes cannot be overemphasized. Considerable time was involved in developing local contacts. Attending meetings and visiting community leaders proved to be important.
- Printed media, especially booklets and brochures, were an effective method of communication and provided the foundation for subsequent audiovisual presentations, workshops and conference discussions and news releases. Simply disseminating publications without follow-up activities probably would have been ineffective.
- The practice of co-sponsoring publications with an existing resource agency proved successful and established a cooperative spirit. To institute management programs in the community, the project staff had to place a resource agency and not the Biological Station at the focal point of program activities. To eliminate the possibility that the Biological Station would be seen as a threatening, competitive organization, the existing agency was treated as the authority and was involved in every stage of program planning.
- The project was successful in using workshops and mini-conferences to allow participants previously involved in successful programs elsewhere to present management options to the local community. Traditional "lectures" by "experts" were minimized, and citizens more readily accepted information from persons they considered their peers.

Federal and state resource management programs often come and go with changing administrations, but local communities still must cope with environmental problems in their area. With a little encouragement and timely technical assistance, effective water quality protection can be implemented at the local level.

ARSLOE '80

by Anna A. Punchak and David E. Lichy

During October and November 1980 the U.S. Army Corps of Engineers' Coastal Engineering Research Center (CERC) and the National Oceanic and Atmospheric Administration's (NOAA) National Ocean Survey jointly hosted the Atlantic Remote Sensing Land-Ocean Experiment, or ARSLOE. Satellites, aircraft, ships, and land, surface and underwater sensors from Federal agencies, academic institutions, private organizations, and four foreign countries converged on Duck, North Carolina, for two months of all-out research. They were there to advance the science of determining how ocean waves are transformed as they progress to shore, to improve storm prediction techniques, and to verify data collection methods.

Command center and base of operations was CERC's Field Research Facility, a laboratory building and a 610-meter pier with a variety of permanent meteorological and ocean-measuring devices. The coordination staff headquartered there for overall direction, logistics, data mangement, and meteorological forecasting.

The experiment went on at three test sites. Remote sensing techniques combined with conventional measuring methods to provide an unprecedented intercomparison data set of land features (the Elizabeth City area), ocean fronts (the mouth of the Chesapeake Bay), and waves (the Field Research Facility pier at Duck).

Ms. Punchak was the data manager for ARSLOE; Mr. Lichy was the experiment coordinator. Both are with the U.S. Army Corps of Engineers' Coastal Engineering Research Center, Fort Belvoir, VA 22060.

THE SENSORS

All three test sites made use of all the ARSLOE airborne remote sensing resources: microwave, x-band and k-band side-looking airborne radar, x-band synthetic aperture radar, scatterometers, radiometers, surface contouring radar, thermal infrared scanners, airborne oceanographic lidar, laser profilometer, and aerial

photography. Each of these systems senses the environment through different mechanisms and so provides different information. Once integrated, that information is a basis for better understanding the character of the surface area being sensed.

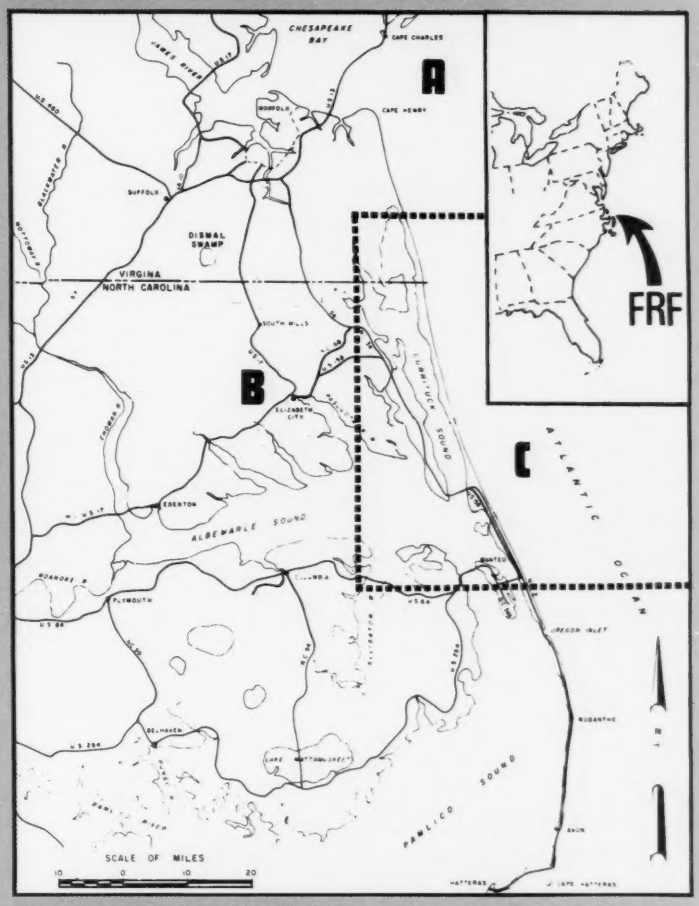
The active microwave imaging side-looking airborne radar and synthetic aperture radar systems produce a photolike image of the land and ocean. Whereas photography reproduces images as the eyes see features, these systems produce images in the microwave region of the electromagnetic spectrum. Land microwave return, or backscatter, is affected by geometry, surface roughness, and moisture content. Ocean microwave backscatter is affected by intensity of ocean waves, currents, wind speed and direction, and varying water body types. Radiometers and scatterometers measure backscatter quantitatively and supply detailed data for application to numerical models.

The surface contouring radar scans beneath its aircraft for three-dimensional information that can be translated into a topography map of land or water. An ocean surface map would show wave height, length, and direction. For ARSLOE the airborne oceanographic lidar and laser profilometer operated in the visible region of the electromagnetic spectrum and provided topographic information similar to that from the surface contouring radar. The thermal infrared scanners produce photolike images that detect differences in surface temperatures, which are affected by material type, moisture content, and surface roughness. Microwave, infrared, and visual spectral data gathered at the same time complement each other.

LAND

Scientists from the U.S. Army Engineer Topographic Laboratories and Water Resources Support Center, the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center, and the Soil Conservation Service focused their remote sensing objectives on a land test site in the Elizabeth City area.

They gathered data on soil moisture and temperature, vegetative type, land use, and cultural features. Of special use at the land test site were two thermal infrared scanners, side-looking airborne radar, and color infrared and



ARSLOE Test Sites. A: Mouth of the Chesapeake Bay (ocean fronts); B: Elizabeth City (land); C: Field Research Facility pier (waves).

CERC Field Research Facility at Duck, North Carolina, command center and base of operations for ARSLOE. (Photos from CERC files.)

Side-looking airborne radar antenna mounted underneath U.S. Army Mohawk.

Waterways Experiment Station participant cleans marine growth from in-situ instruments.

University of Delaware Research Vessel Cape Henlopen, with cloverleaf buoy.

black and white panchromatic aerial photography. This part of the experiment will give researchers coincident remote sensing data and supporting ground truth to improve photo analysis techniques and to verify hydrological models.

OCEAN FRONTS

At the mouth of the Chesapeake Bay the ocean fronts experiment objectives were to detect different water bodies and to develop their microwave backscatter characteristics. Specifically studied was whether the synthetic aperture radar can provide images of large ocean features or fronts. Previous synthetic aperture radar data from SEASAT-1 (a proof-of-concept satellite that operated for only 100 days in 1978) revealed macroscale structures of the ocean surface. The proposal has been made that these features were related to ocean fronts, and ARSLOE attempted to quantify the radar imagery.

The U.S. Marine Corps, NASA, the Kentucky Air National Guard, and the 15th Military Intelligence Battalion from Fort Hood, Texas, put aircraft over the area, and the Old Dominion University's research vessels collected water samples. Scientists from the Environmental Research Institute of Michigan, NASA Langley Research Center and Wallops Flight Center, and Scripps Institute of Oceanography were able to qualitatively verify patterns noted in previous active microwave imagery.

WAVES

The major emphasis of ARSLOE was to evaluate ocean wave theories, numerical models, and measuring techniques. This part of the experiment went on near CERC's Field Research Facility pier. Many of the remote sensing and in-situ (conventional) systems for measuring ocean waves had been tested independently, but ARSLOE marked the first time such a large variety had been brought together for simultaneous data collection.

Gathering ocean data by conventional methods is difficult because of harsh environment, marine growth on instruments, and dynamic energy of the surf zone and sea. Logistical deployment, maintenance, and recovery of a large number of in-situ systems was an enormous job. U.S. Army Cap-

tain Dennis McCann, ARSLOE logistical coordinator, says:

"The challenges of coordinating and then executing the numerous facets of such a large experiment under other than ideal conditions is truly a trying task. Whenever dealing directly with overcoming or predicting the consequences of nature, particularly in the dynamic realm of the air, sea, and land interface, you can only hope for a lot of luck or for having at your disposal enough alternatives to meet every possible situation."

Keeping a high percentage of systems operational required diving teams, ships, cranes, beach-adaptable vehicles, and, especially, people.

The essence of the remote sensing and in-situ comparison was to demonstrate that remote sensors can provide the same wave information with fewer logistical needs than in-situ systems and eventually at lower cost. When the remote sensors are deployed at ground sites or in satellites the repetitive data frequency for wave information can be easily obtained.

Directional wave spectra (aspects of the direction from which waves approach the beach) are major factors in understanding wave energy in the coastal zone. Detailed directional wave data were measured by a variety of methods. Buoys served as surface and underwater verification for the remote sensors—and vice versa. For the first time in one location six different directional wave-measuring buoys were tested—one each from Japan, France, Canada, and North Carolina State University, and two from NOAA's National Ocean Survey.

The French and Japanese buoys were "old hands." The Nereides Co. of France has its WADI (wave directional) buoys deployed in various locations throughout the world. The University of Delaware's Research Vessel *Cape Henlopen*, under contract to NOAA, hosted Dr. Hisashi Mitsuyasu and Mr. Tadao Honda from Kyushu University, Japan, for their contribution to the experiment—the cloverleaf buoy. This buoy had been field tested for ten years and served as the calibration for all the directional wave spectra measuring systems. The buoy was tethered to the *Cape Henlopen* for power and data relay; deployment and retrieval sometimes meant facing seas that approached five meters.

Buoy from the Canada Centre for Inland Waters.

The Canadian and the North Carolina State buoys were tested for the first time in ocean water, although the buoy from the Canada Centre for Inland Waters had been tested extensively in the Great Lakes. Whereas the other buoys had set timing devices for data collection, the Canadian buoy had an anemometer that activated the system for more concentrated data collection during high winds and waves and was equipped with solar panels for auxiliary power. North Carolina State's buoy, a relatively inexpensive system, was modified on site and later at the university for power telemetry, recording, and stability in severe weather.

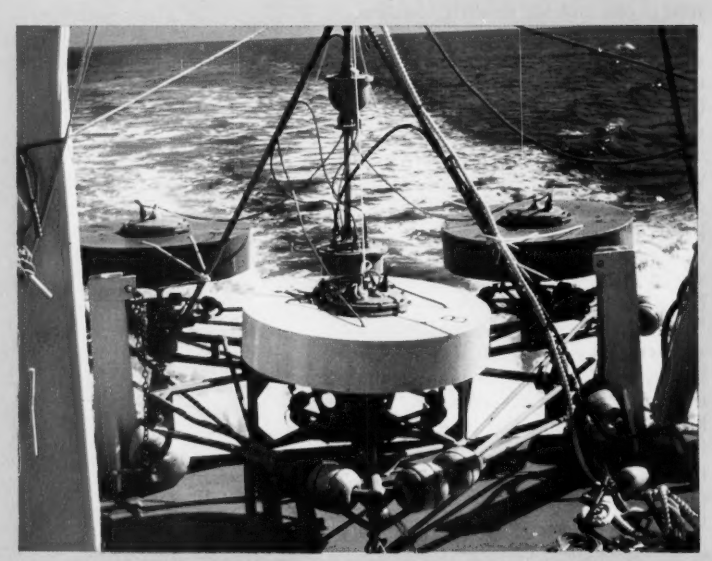
NOAA's two directional buoys were the ENDECO (Environmental Devices Corporation), of pendulum design, and the X-ERB (Experimental Environmental Research Buoy), a discus of 10 meters. The X-ERB had been moved in the summer of 1980 from the Gulf of Mexico, refurbished and deployed 36 kilometers off the coast by the U.S. Coast Guard. ARSLOE marked the first time the buoy had been tested in deep ocean water for directional wave spectra. The data were telemetered to the Geostationary Operational Environmental Satellite and relayed to the National Data Buoy Office for analysis.

Nearshore underwater in-situ wave directional measurements were made by bottom-mounted systems of current and pressure measuring devices from Scripps Institute of Oceanography, Woods Hole Oceanographic Institute, the University of Florida, and CERC. Although underwater sensors, unlike buoys, are not affected by surface ship traffic, ice, high waves, or wind, they present the problems of data recording (on board or by cable through surf zone) and underwater maintenance.

Besides the directional sensors were seventeen one-dimensional wave height and period (the time between waves) measuring devices. These sensors were used to develop a data base for determining wave homogeneity and to detect spectra changes as the waves travel from deep ocean to the surf zone.

Remote sensing systems for directional wave spectra consisted of both ground and airborne sensors with the majority operating in the microwave (radar) region. One ground system was the high frequency radar provided by the NOAA Environmental

NOAA's 10-meter discus buoy, the X-ERB.



The Japanese cloverleaf buoy served as the calibration for all ARSLOE directional wave spectra measuring systems.

Research Laboratory, which was testing different antenna designs. This system could scan a 40-by-40 kilometer area of the ocean and provide near real-time data on surface currents and, with further processing, on wind direction. Two additional radars mounted on the Field Research Facility pier scanned up to six kilometers seaward. These radars, modified by CERC, provided an image from which wave period and direction can be measured with the resolution necessary for understanding the nearshore coastal processes. Airborne systems reflected both state-of-the-art and new research techniques. Side-looking airborne radar and synthetic aperture radar provided imagery for wave direction and length. A variety of microwave and laser nadir looking sensors were used for wave height and length information. Experimental airborne sensors were tested for application to satellite platforms.

Ocean researchers were exhilarated when a storm blew up on October 23 and lasted for five days. Waves nearly five meters high and winds over 16 meters per second were recorded. When a weather front passed midway through the storm, winds abruptly shifted 180 degrees and created a prime event for studying ocean wave theories. Researchers now have a "captured" storm, well documented with growth and decay of waves, energy transfer, and the effect of winds blowing with and against the direction of wave travel.

ARSLOE initiated a new era in measuring ocean waves by remote sensing techniques. Now the oceanographic research community has the data base to prove or dispel various techniques and claims. The data collected will certainly improve many of the existing wave theories; this could result in a better understanding for designing coastal structures, harnessing wave energy, shore erosion, weather prediction, and developing future remote sensing measuring systems. Wadsworth Owen, of the University of Delaware College of Marine Studies, says:

"Increasing the accuracy of wave forecasts is an ambitious goal, but considering that wave motion affects everything from coastal shipping to naval operations and sport fishing, tests like ARSLOE are vital steps forward."

NOAA Environmental Research Laboratory high frequency radar.

ARSLOE came complete with a storm.

ARSLOE PARTICIPANTS

FEDERAL

DEPARTMENT OF DEFENSE

Department of the Army
- Corps of Engineers
  - Coastal Engineering Research Center (CERC)
  - Engineer Topographic Laboratories
  - Waterways Experiment Station

Department of the Navy
- Naval Research Laboratory
- Naval Eastern Oceanography Center

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration (NOAA)
- National Ocean Survey
- Environmental Research Laboratory
- National Weather Service
- Engineering Development Laboratory
- Test and Evaluation Laboratory
- Sea-Air Interaction Laboratory

National Aeronautics and Space Administration (NASA)
- Wallops Flight Center
- Goddard Space Flight Center
- Langley Research Center

ACADEMIC

- North Carolina State University
- Old Dominion University
- University of Florida
- Scripps Institute of Oceanography
- Woods Hole Oceanographic Institute

PRIVATE

- Environmental Research Institute of Michigan
- Johns Hopkins Applied Physics Laboratory
- TSI Incorporated

FOREIGN

- Canada Centre for Inland Waters
- Norwegian Hydrodynamic Laboratories
- Nereides Co., France
- Research Inst. for Applied Mechanics, Kyushu University, Japan

SUPPORT

DEPARTMENT OF DEFENSE

- Water Resources Support Center
- 30th Engineer Battalion (Topo)
- Davison U.S. Army Airfield
- 15th Military Intelligence Battalion
- 3d Marine Aircraft Wing, Fleet Marine, Pacific
- Construction Battalion Unit 415 (Seabees)
- 123d Tactical Reconnaissance Wing, Kentucky Air National Guard

DEPARTMENT OF COMMERCE

- NOAA Data Buoy Office
- National Oceanographic Data Center
- National Environmental Satellite Service
- Technical Development Laboratory

DEPARTMENT OF TRANSPORTATION

- U.S. Coast Guard

In addition to the excellent data set for sensor intercomparison, another even more singular set exists. The configuration of sensors covered a 40-by-40 kilometer region and yielded a dense network of wave measurements of wind speed and direction, air-sea temperature, sea bottom roughness, and ocean bottom material type. What energy impacts on the coastal region is a basic question of coastal engineering that directly relates to engineering design of structures and calculations of longshore transport (the movement of material). The refinement of existing theories concerning the interaction of sea, air, and land and resulting numerical models can produce a more cost-effective design procedure for coastal projects.

The scientific community will be able to draw upon this unprecedented data set in continuing research of ocean waves. The NOAA Environmental Data Information System National Oceanographic Data Center will archive the entire ARSLOE set, and all information will ultimately be available for the cost of duplication.

Participants in a workshop held in February reviewed the data set and developed a plan for initial analysis. Two working groups for wave measurement comparison and theoretical studies were formed: one for shallow water waves and currents, one for offshore waves. Participants will meet periodically to discuss overlapping data and similar problems. A follow-up workshop is scheduled for September in San Francisco during the Directional Wave Spectra Application Seminar. ■

Evaluating River Recreation Potential

by Earl C. Leatherberry

The more than 3.2 million linear miles of rivers and streams in the continental United States serve a variety of purposes—sustenance, transportation, energy, commerce, recreation. Because rivers are used for many commodities, most decisions about allocating their resources are based upon market considerations; for example, the construction of hydroelectric plants depends upon the demand for electricity.

In recent years, however, noncommodity uses of rivers have increased. One such use in particular, recreation, has become much more popular. During the 1970s, the number of visitors to the nation's rivers increased dramatically as many people took to canoeing, kayaking, and whitewater rafting. (*Table 1*) The popularity of river recreation has not been confined to the "wild" or "natural" rivers but extends to all types—urban and rural, placid and fast-flowing, polluted and clean.

Probably the most urgent river management problems involve allocating river resources for recreation. To make informed decisions, river managers need techniques that objectively assess recreation potential.

Within the past 20 years several methods have been developed to evaluate that potential. This article summarizes some of the important methods, explores several issues relating to river recreation evaluation, and suggests how to improve evaluation methods. The focus is on concepts rather than on a single new technique. "Recreation potential evaluation" as used here refers to the assessment of features or conditions in riparian environments that may provide recreational values.

Mr. Leatherberry is a geographer with the North Central Forest Experiment Station of the U.S. Department of Agriculture Forest Service, St. Paul, Minnesota 55108. This article is a modification of his "River Amenity Evaluation: A Review and Commentary," in *Water Resources Bulletin* (15)5:1281–92.

Table 1. RECREATIONAL VISITS TO SELECTED U.S. RIVERS (1970-1979)

	NUMBER OF VISITS FOR YEARS DATA HAVE BEEN COLLECTED									
Rivers	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Allagash River (Maine)	5,460	6,345	8,260	8,337	7,477	9,447	8,619	9,278	9,734	8,932
Chattooga River (South Carolina, Georgia)	800	800	7,600	21,000	28,800	22,800	15,200	17,400	29,000	28,800
Colorado River, Canyonlands National Part (Utah)	889	1,670	2,439	4,422	4,096	4,042	4,869	4,809	5,595	5,786
Colorado River, Grand Canyon National Park (Arizona)	9,935	10,885	16,432	15,219	14,253	14,305	13,912	11,830	14,356	14,576
Green and Yampa Rivers, Dinosaur National Monument (Colorado, Utah)	9,762	14,145	17,159	16,739	12,874	13,710	13,580	13,114	14,559	12,803
Pine River (Michigan)	—	50,000	—	64,000	—	80,000	90,000	96,000	76,341	69,836
Salmon River, Middle Fork (Idaho)	3,028	3,250	3,972	4,372	4,036	4,682	5,964	3,767	6,904	7,026
Snake River, Grand Canyon (Wyoming)	—	—	—	27,364	36,462	43,576	55,739	60,914	68,959	—
St. John's River (Maine)	—	—	—	—	—	1,151	1,294	2,408	2,639	2,971

Methods

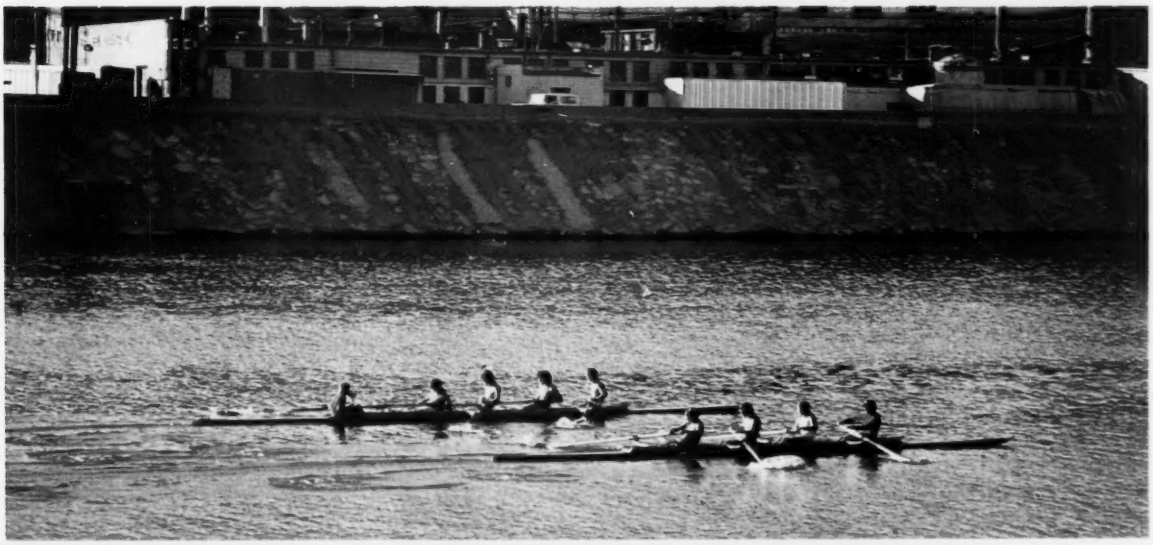
The following river recreation potential evaluation methods vary in purpose and complexity, but all have been field tested and/or applied. (*Chart 1*)

Probably the earliest systematic quantitative approach was developed by Frank and John Craighead (1962). Their approach evaluates the potential of rivers for boating, fishing, and hunting. The areas evaluated range in size from an entire watershed to a stream or shore section a mile or less long. Twenty variables which relate to boating, fishing, and hunting are rated. The scores are intended to reflect the relative importance of each variable as a part or character of the resource. The values from each variable are summed to measure the quality of the resource.

The method developed by Dearinger (1968) is one of the most comprehensive. It is designed to evaluate the recreation potential of watersheds or streams located near urban areas and draining areas of less than 100 square miles. It evaluates a stream's potential for camping, fishing, picnicking, trail development, aesthetic enjoyment, and establishment of natural, scenic, and historic areas. Numerical ratings from 0 to 10 are assigned to each of 14 elements considered to determine the quality of an activity or area. The ratings assigned reflect the suitability of the element for an activity or area and are weighted to yield a total score. The sum produces a value which expresses the potential for each recreation activity or area. This value can be converted to a percentage to compare potential sites between and within watersheds.

MacConnell and Stoll (1968) used an aerial photogrammetric technique to identify, evaluate, and classify land uses and vegetation patterns suitable for recreation development. Two sets of aerial photographs taken 10 to 13 years apart were analyzed to determine past land uses and development trends. Maps classifying land within 1000 feet of the river's edge were prepared. The land use classifications were agriculture or open space, mining, urban, outdoor recreation facilities, riverbank and edge of riverbed, forest land, and wetland. With this data, land adjacent to the river is evaluated for recreation development potential. The land is analyzed for access, parking areas, picnic-camping areas, scenic overlooks, aquatic vegetation, physical obstacles in the water, and other factors.

Morisawa (1971) developed a method to evaluate the recreation quality of free-flowing rivers, using two techniques of investigation. First, sample sites are marked on topographic maps at intervals of approximately three miles. A field survey party visits each sample site and records data on hydrologic conditions, geology and landscape, and aesthetic characteristics. Second, a ground crew reconnoiters the rest of the river and its tributaries. The recreation potential of a watershed is evaluted based upon the type of recreation activity and whether the activity is seasonal. Activity types are grouped into three classes:



River recreation in an urban setting.
(Photos by author unless otherwise noted.)

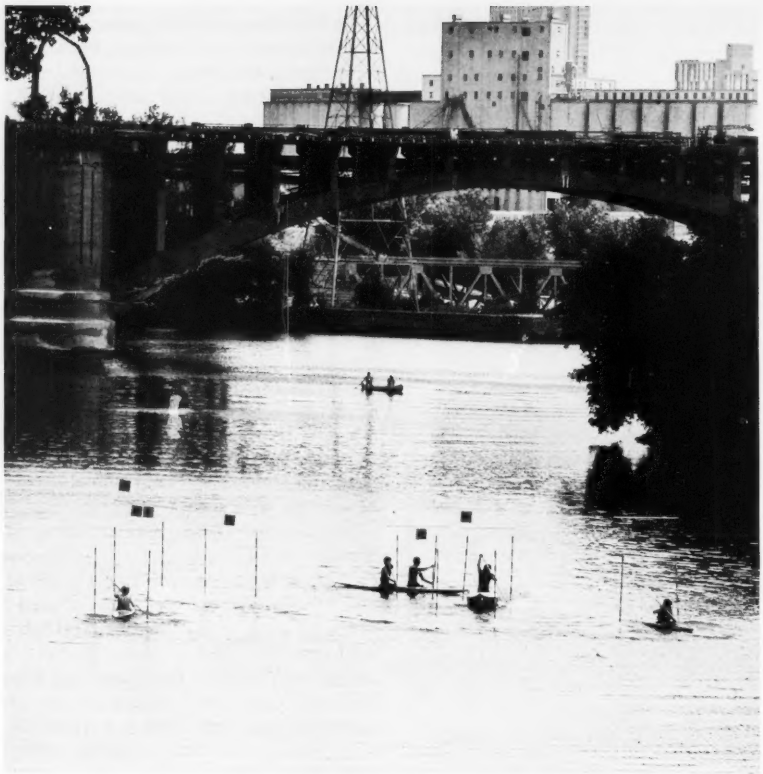


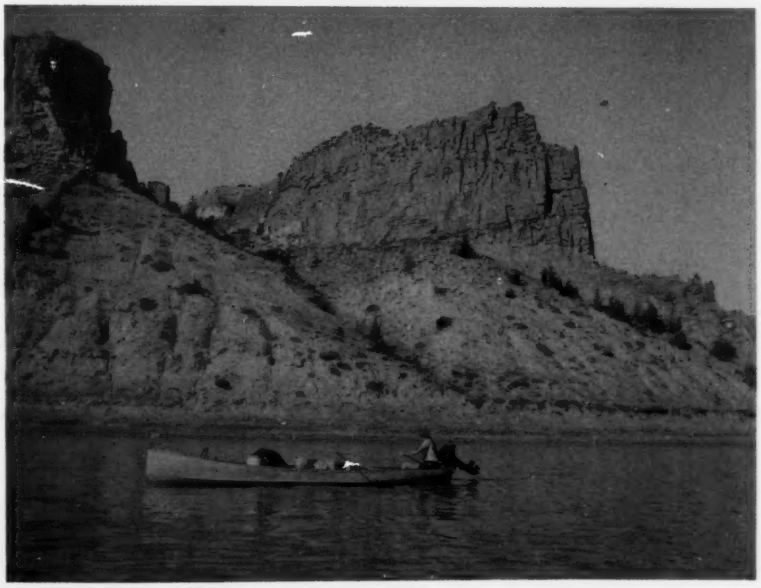
Chart 1. DEVELOPERS, AND REFERENCES FOR METHODS REVIEWED

DEVELOPERS		REFERENCES
Frank and John Craighead	1962	River system recreation classification, inventory and evaluation. *Naturalist* 13(2):2-19.
John A. Dearinger	1968	*Aesthetic and recreation potential of small naturalistic streams near urban areas.* University of Kentucky, Water Resources Research Institute, Research Report 13. Lexington, Kentucky. 260 pages.
William MacConnell and G. Peter Stell	1968	*Use of aerial photography to evaluate the recreational resources of the Connecticut River in Massachusetts.* University of Massachusetts, Agriculture Bulletin 578. Amherst, Massachusetts. 65 pages.
Marie Morisawa	1971	*Evaluation of natural river environments.* Phase II, Final Report. U.S. Department of the Interior Water Resources Research, Antioch College, Yellow Springs, Ohio. 143 pages.
Pacific Northwest River Basin Commission	1974	Recreation (Chapter 12). In *Anatomy of a river.* Northwest Region, Bureau of Outdoor Recreation, Vancouver, Washington, pp. 123-147.
Michael Chubb and Eric H. Bauman	1977	Assessing the recreation potential of rivers. *Journal of Soil and Water Conservation* 32(2):97-102.
Claude E. Terry	1977	A filter system for determining river suitability for National Wild and Scenic River status. In *Proceedings, River Recreation Management and Research Symposium.* U.S. Department of Agriculture Forest Service, General Technical Report NC-28. North Central Forest Experiment Station, St. Paul, Minnesota, pp. 372-379.

(1) active outdoor recreation, (2) active water recreation, and (3) nature observation and interpretation. Use periods are organized into four time categories: (1) most or all activities are possible year-round; (2) most or all activities are possible, but only seasonally; (3) some activities are possible year-round; and (4) some activities are possible seasonally. Recreation potential is determined by considering the activity and its extent during the year based upon the four time categories.

The Pacific Northwest River Basin Commission (1974) developed a method that evaluates the relative effects of various stream flows on recreation opportunities. It can be used only on rivers where water flows can be regulated through dam releases. Water flows are controlled and at each discharge observers are stationed at sites downriver to record the effects. They measure water velocities, high water velocities, high water lines, and beach slope. Observers record each flow's effect on pool and riffle areas, on exposed beach, on channel width, on navigation condition, and on visual and sound quality. Each site is rated for the effects of flows on (1) power boating; (2) swimming, wading and water play; and (3) picnicking and camping. To determine the recreation potential of each site at the different flows, the relative adequacy of each flow is appraised on a five-point scale. The ratings range from a minimally acceptable flow which provides for the most limited recreation use to a maximally acceptable flow which is assumed to be the highest rate usable by the recreationist.

The RIVERS method (River Inventory and Variable Evaluation for Recreation Suitability) was developed at Michigan State University by Chubb and Bauman (1977). This method, building on previous techniques, is designed to permit the quantitative comparison of several rivers in a large geographic area such as a national forest or state. Evaluations are made of a river's potential for 16 recreational activities. To evaluate the recreation potential, data on eight groups of environmental variables (67 in all) are collected from topographic maps, aerial photographs, and a field survey. The variables are rated on a five-point scale. The highest score (five points) is assigned to the most favorable situations for the most activities. A computer program analyzes the data and selects the appropriate variables for evaluating the potential for a particular recreation activity. Values for the selected variables are "transformed," depending upon whether or not a variable has a plus or minus correlation with the activity concerned. For example, rapids are generally regarded as positive for wilderness canoeing but negative for power boating. The transformed values are weighted to reflect the relative importance of each in determining the feasibility of a particular activity. The weighted scores are summed for each variable and expressed as a percent of the max-



A spectrum of river floating opportunities is needed. Some people enjoy solitude . . .

imum possible score. The percents are compiled into a matrix by activity and river segment and then plotted on a map.

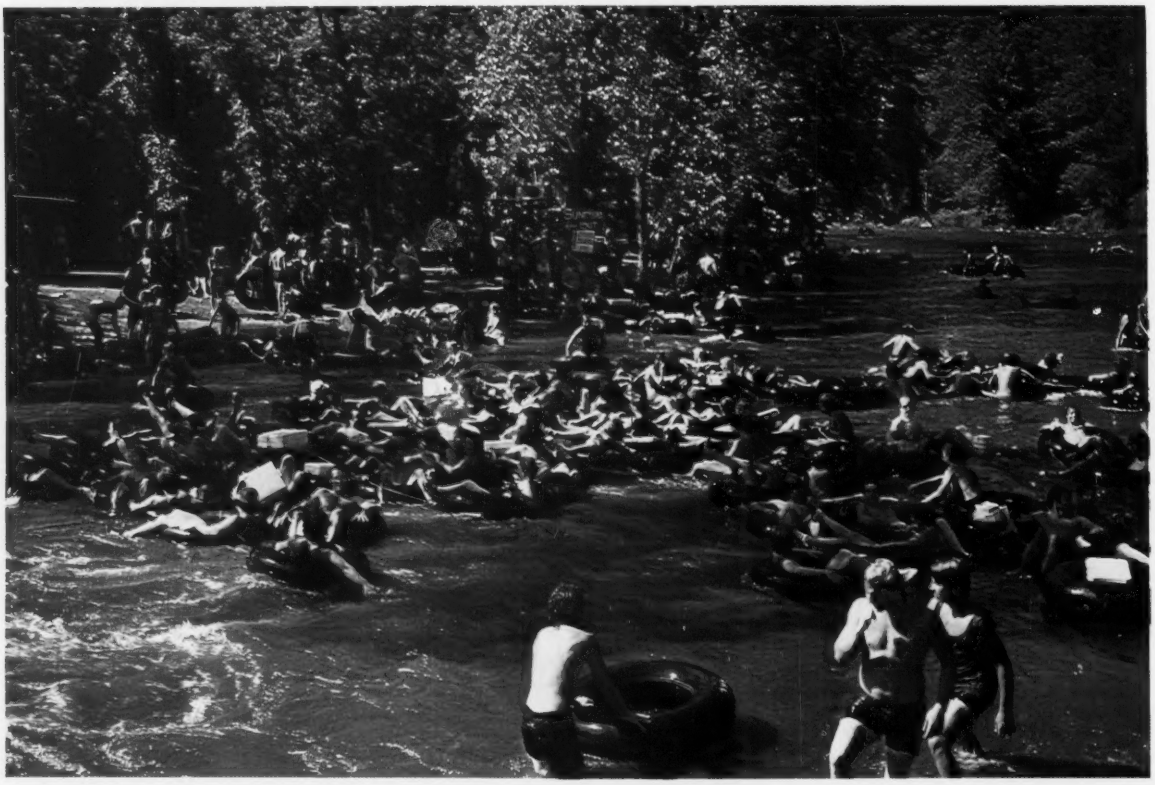
Terry (1977) used a method to identify rivers that meet the criteria of the National Wild and Scenic River System. The method, designed for a wide area, uses a set of "filter" criteria for determining which rivers to include in the system. Five filters are arranged so that the first few remove most rivers from study. Each filter progressively increases the standards. Filter one, stream length, identifies all rivers 25 miles or more long. Filter two surveys streams for water quality. Filter three assesses urbanization and drops from consideration rivers deemed too developed. Filter four consists of direct field inspections of the river. Filter five, water flow, focuses on whether a river has enough water during normal years to accommodate water-based recreation. The filtering process also incorporates input from interested individuals.

Limitations

River recreation potential evaluation has made many advances over the years, from the Craigheads' method to other innovative approaches. (Annotated bibliographies that briefly describe these and other approaches can be obtained from the author.) These methods attempt to evaluate recreation potential by assessing the utility of physical characteristics and other environmental effects for recreation activities. But the user must make subjective judgments about the types of characteristics and activities to include in the evaluation. It may be necessary to make intuitive decisions, but the influence of personal choice, convenience, or other biases is not known, and the rationale for using a particular characteristic or activity is not always clearly stated.

To determine recreation potential, some methods assign numerical ratings to environmental conditions. The rating scheme should be capable of being reproduced by others with comparable results. Point values and their sum derivatives may not adequately represent the influence of various environmental conditions. A river with constantly low point "scores" may in aggregate be

. . . others enjoy companionship. (David Lime)



more suitable for a particular form of recreation than is a river with a few high point scores. The effect of very high and very low point values and the point increments assigned to environmental features may not adequately reflect recreation potential.

The utility of a particular method is influenced by the type of environmental features used. For example, one method uses environmental features that are most likely to be found in remote areas; another uses features more prevalent near urban areas. Yet another method uses features likely to be found in both wild and urban areas. When applying or selecting a particular method, the user should be aware of its scope.

Rating enviromental features for various types of activities may create problems. For example, certain environmental features may suggest that a river is highly suited for water activities. But if water activities such as speed boating and canoeing are grouped into one "boating" category, the potential for conflict is hidden.

None of the methods fully addresses the legal and institutional implications of river resource allocation decisions. A river could be highly suited for recreation activities, but more compelling uses may preclude them. Nor do the methods address the compatibility of commodity uses of rivers (such as barge traffic or hydroelectric production) with recreation. The mere presence of commodity uses should not preclude recreation activity.

Some methods appear to be relatively inflexible. For example, using fixed standards or "filters," such as the length of a river segment, limits the flexibility to accommodate exceptional cases. Also, some methods tend to be fixed in time and do not adequately represent the dynamic nature of the resource and the potential recreationist. For example, seasons play a major role in the recreation potential of a river—with even insect infestations an influence. Thus, evaluations should represent conditions likely to be found during various periods of the year.

The flow characteristics of some rivers affect the recreational opportunities available. (David Lime)

Multiple use can create dissatisfaction. (David Lime)

Suggestions

If river recreation continues to increase in popularity, more refined and comprehensive evaluation methods will be needed:

- Future methods will have to be capable of quantifying recreation in the same way that market concepts are applied to the more traditional commodity uses. It will not be enough to allocate resources based on subjective or incomplete appraisals. If river recreation has to compete with other uses, it has to be evaluated in equivalent terms.
- Future methods should be capable of predicting change and its impact on recreation participation. Environmental changes should be incorporated into evaluations, and scenarios should be presented for each alternative.
- Opposition to administrative designation of rivers for recreation will increase, especially from local residents and competing users. Future methods should be capable of incorporating input from the interested public.
- Future methods should incorporate concepts and techniques that measure recreationists' feelings about specific environmental features. For example, some people perceive rapids as hazards; others, such as canoeists, perceive them as assets.
- Future methods should place more emphasis on the type of experience to be provided on a particular stretch of river. Planners and managers need to view a river in terms of its potential to provide a particular kind of recreation experience, not just its ability to withstand human impacts.

The available approaches can be developed, refined, improved. This task should not be left to researchers alone. River managers—the people who have gotten their feet wet—are in a good position to know what needs to be done. The coming years will be important as it becomes more difficult to protect those values that attract people to rivers. But the expected difficulty should not keep us from trying. If there are to be high quality, diversified river recreation opportunities in the future, it will be because of what we are doing today. ■

PRESERVING THE PAST

by Bob Norton

The Tennessee-Tombigbee Waterway, now under construction in Alabama and Mississippi, is the largest single public works project ever undertaken in the United States, and may well be the largest earth moving project in the history of man.

The new waterway, from Demopolis, Alabama, to the Tennessee River, will extend some 232 miles and use a series of 10 locks that will provide a total lift of 341 feet. From a purely engineering standpoint, the project is one-third again as large as the effort expended in building the Panama Canal. It will create an entirely new route between the Gulf Coast and much of the interior of the United States.

The project is threefold: a River Section following the existing Tombigbee channel, a Canal Section that will be constructed parallel to the upper river and Mackey's Creek, and a Divide Section along a 27-mile cut that will connect it with the Tennessee River.

Although visionaries had seen the economic advantage of a connection between the Tennessee River and the Gulf of Mexico as early as the eighteenth century, Congress did not authorize work until 1946. Construction on the first lock and dam, at Gainesville, Alabama, was undertaken by the U.S. Army Corps of Engineers in 1972 under the auspices of Public Law 86-523. This legislation, and later amendment, also called for programs of archeological study at Federal reservoir projects prior to construction and authorized spending up to 1 percent of total construction costs for cultural resources studies aimed at recovering important prehistoric and historic data and otherwise mitigating project impacts. This funding, in the Tenn-Tom Basin, was provided by the Corps' Nashville and Mobile Districts.

Mobile and Nashville Districts, in conjunction with the Interagency Archeological Services in Atlanta, and the Historic Preservation Offices

Mr. Norton is editor-in-chief of *Water Spectrum*.

Surface collection of artifactual material was an early phase of archeological work along the Tenn-Tom Waterway. Four meter square grids are taped out along a north-south axis so that recovered material's original location can be exactly plotted on the site.
(Photos by the author unless otherwise stated.)

of Alabama and Mississippi, formulated a comprehensive mitigation plan calling for Corps' funding of all costs and establishing the Tombigbee River Multi-Resource District as a five-mile-wide corridor extending some 130 miles from Gainesville to Paden, Mississippi. The Multi-Resource District was included in the National Historic Register in 1977.

The District is a viable mechanism for managing those cultural resources that would be affected by the waterway construction and set the stage for answering research questions and strategies for data recovery from historic and prehistoric resources.

The mitigation effort focuses on two approaches to preserving endangered cultural resources: mitigation by preservation, and/or conservation and data recovery. When possible, construction planning and scheduling would be altered to avoid impacting significant resources; when impact on resources could not be avoided, data recovery would take the form of archeological excavation. The archeological mission consists of three phases:

- Survey of the entire impact area to determine what type of sites (habitations) the area holds;
- Testing of those sites from which more information is needed to evaluate their potential; and,
- Excavation of those sites that will provide sufficient information to understand previous inhabitants of the Tombigbee River Valley.

Various archeological projects were then contracted out to such institutions as the University of Michigan, the University of Pittsburgh, Mississippi State University, the University of Alabama, the University of West Florida and private interests.

This site, on a bluff overlooking the Tenn-Tom Divide Section, gave up a large number of artifacts during surface collection—an indication that more material is beneath the surface and excavation may be worthwhile.

Historic sites that would be affected by the waterway were also surveyed for mitigation. Research designers wanted to insure that historic preservation did not take a back seat to prehistoric work, as had so often been the case. Historically significant properties were defined as including standing structures, house sites, town sites, bridges, ferry landings and sunken vessels. The archeological potential for such sites to shed light on nineteenth and early twentieth-century rural domestic lifestyles was recognized. Old newspapers, French archival records and other sources served as reference material.

Resources as diverse as a mill at Bay Springs, the Waverly Cotton Plantation near Columbus, and sunken vessels such as an early twentieth-century stern-wheeler were designated under the historic aspects of the mitigation plan. Whenever possible, these sites would be incorporated into Corps' recreation areas, and the restored moments of history would be opened to the public. A total of 150 historic sites was considered of significance for mitigation.

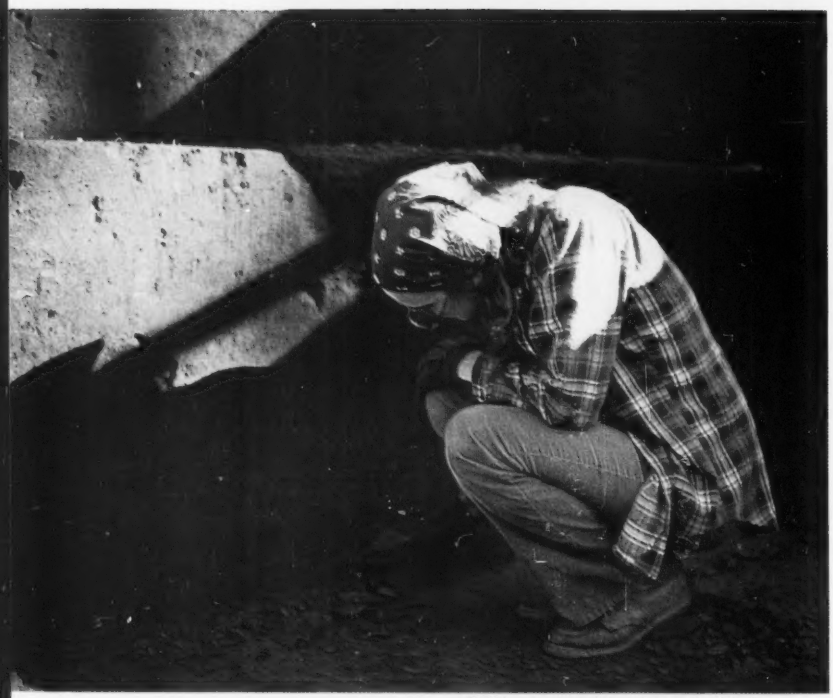
The first unexpected construction holdup came in 1978, when bulldozer blades uncovered the remains of a prehistoric archeological site near the Columbus Lock and Dam area. Work halted to allow contract archeologists to excavate the site, which proved to be a substantial village area dating to about 900 A.D.

Dr. Judith Bense, an archeological research professor from the University of West Florida, is the principal archeological investigator under contract to the Mobile District. Her area of interest eventually was to cover the waterway from Mackey's Creek in the north to Aliceville, Alabama, in the south.

"Basically, what we are trying to do here—before the water covers the evidence—is to reconstruct the past lifeways of the prehistoric peoples of the Tombigbee," she says. Under her supervision are about 80 archeologists, primarily anthropology and archeology majors from colleges and

The first step in full excavation is digging a deep stratigraphic trench across the site to expose features—pits, hearths, postmolds, etc.—that will in turn assist the archeologists in determining what areas to explore further. (Photo courtesy of Dr. Judith Bense.)

West Florida University contract archeologists measure an aboriginal fire hearth uncovered by excavation work in the Tenn-Tom Waterway impact area.
(Photo by Dr. Bense)



Soil is removed in extremely thin layers to protect artifactual remains from damage. The dark soil layers around the excavated grid are evidence of centuries of aboriginal habitation of the site.

universities across the United States. From her headquarters in the small Mississippi town of Fulton, Judy directs excavations and laboratory work from digs over widely separated areas of northeastern Mississippi. She had been in the field 13 months when interviewed for *Water Spectrum*.

"We have two basic problems built into the work here," she says. "Funding is obviously limited, and we just don't have the time. The water is coming.

"The best you can do is sample, and hopefully get a representative picture of prehistoric life in the valley . . . how it changed through time, ideally *why* it changed . . . then preserve the picture for the future.

"We started out with the basic bookwork that precedes any archeological undertaking. You read histories of the area, look at old maps, try to determine what, if any, archeological work has been done there in the past.

"Then you go into the area and establish a rapport with the local people who really know where everything is. You literally 'pull up to the pot-bellied stove' with the local people and convince them of the seriousness of your work and the value that it has to the future. If you do this right . . . make some friends, the local amateur collectors are going to take you out in their pickup trucks and show you the sites they are familiar with and where they have been picking up artifacts over the year."

And, it works.

In late spring of 1980, Dr. Bense was notified of the existence of a small prehistoric mound in the pool above the Tenn-Tom's Lock D by a "local informant." The mound was symmetrical in plan and approximately 60 meters in diameter. Excavation revealed an undisturbed habitation about 18 centimeters deep and just under the plowzone. Artifactual material recovered included projectile point fragments (what the layman calls "arrowheads," according to Dr. Bense), blades, choppers, and a single specimen of ceramic pottery.

"The site represents an occupation during what we call the Archaic Period," she stated. "That would be about as early as anything we have definitely dated in the basin so far. We break these aboriginal periods into Paleo, or Early Man, then Ar-

chaic, Woodland and Mississippian. We have one very probably Paleo site near Aliceville, but most of the digs are uncovering Archaic and Woodland habitations. We have found no Historic Aboriginal Period evidence in the basin at all, which is unusual. We date the Historic Period from about the mid-sixteenth century when Hernando DeSoto visited the area.

"Ceramic pottery makes its appearance at about 1000 B.C. and begins the Woodland Period. Metal culture begins only post-contact with Europeans, although we do occasionally recover metal bead ornaments earlier than that. Ceramics are a great diagnostic tool, as we can usually date the site from ceramics." (On one excavation site the author picked up a ceramic fragment, or sherd, that Judy was able to immediately date as being from 11 to 12 hundred years old.)

"We have located 682 archeological sites within the Multi-Resource District," Judy continued. "They span time from about 12,000 B.C. to 1900 A.D. We are disappointed in the scarcity of habitations prior to the Archaic Period, but we continue to look. A mastodon skeleton with a Paleo projectile point in proximity would be wonderful, but we haven't found it yet. Through pollen and soil analysis we can reconstruct the environment these people lived in back to about 20,000 years ago—the end of the last Ice Age—but we don't find evidence of the people themselves. And, we don't know why.

"The research designers wanted specific answers to the Paleo occupation questions in the Tenn-Tom Basin. When were they there, how many, what were they doing, how did they exploit their environment? We are just not able to provide any answers yet.

"When we get into the Archaic Period, from about 11,000 B.C. to 1000 B.C., we can make reconstructions. We know what those people were doing, and their successors forward through time. For example, in the Middle Woodland Period, burial mounds begin to appear. When we get into the Mississippian Period, we start seeing temple mounds and ceremonial centers. The village sites become larger and farming characterizes the lifestyles, as opposed to the earlier hunting and gathering. There is a major temple mound site

Excavation of the "Dogwood Mound" south of Columbus, MS. The mound had earlier been damaged by amateur artifact collectors.

This aboriginal rock shelter at Bay Springs in the northern portion of the Tenn-Tom Waterway was excavated by the University of Pittsburgh under contract to the Corps of Engineers.

(Lubbub Creek) about 30 miles below Columbus that another university worked on."

Water Spectrum visited test excavations at one such burial mound, the Dogwood Mound, with Dr. Bense. Mike Rodeffer was in charge of the archeological crew there.

"We have a mound here about 14 meters in diameter and 1.8 meters high," Mike said, "but it has been dug into by amateur collectors already. We are about three quarters into it, and haven't gotten beneath the disturbed soil horizon yet. We are getting some datable ceramics, but they are all mixed up from earlier digging.

"Intact or complete ceramics are extremely rare in the basin. You occasionally find whole pots in ceremonial contexts, but we haven't encountered that here yet. There are ceramic sherds, little pieces, all over the district. But they are in middens, trash heaps."

Each field crew works under a field director, like Mike, who coordinates with Judy Bense. Under the field directors are four team leaders, each supervising from three to six crew persons. About half the crew are women. Because of the time constraints ("The water is coming!"), foul weather does not halt the fieldwork.

"We get rained on, snowed on, freeze half to death or broil, but we stay out here," according to Mike Rodeffer. His crew, half of them digging and half water-screening excavated soil for small artifactual samples missed in the digging, shares his enthusiasm for the work and disdains the vagaries of weather they work in.

Riding back from Dogwood Mound to the lab and headquarters in Fulton, July talked about the apparent lack of historic Indian occupation in the basin.

"According to DeSoto's Chronicles, he encountered Chickasaws in the central and upper portions of the Tombigbee and Choctaws in the lower basin. Old maps, though, show a general lack of historic Indian towns along the waterway. It could have been a boundary area and hunting ground, as opposed to habitation," she continued, "but there is a definite gap here between prehistoric habitations and historic. We just don't know the pattern of their occupation, but it appears their major

The holding area at West Florida University's lab in Fulton, MS., with plastic bagged artifacts just in from the field. Especially important specimens are packaged separately within the containers, which are marked according to the recovery site, grid and depth. The artifacts will first undergo a thorough washing and drying.

villages were just outside the valley on the ridges."

As of press time, the West Florida archeologists had not definitely identified a single historic Indian site.

"I guess the most interesting artifact we have uncovered, at least from a layman's viewpoint, would be the canoe," she added. "We have an intact aboriginal dugout canoe that dates to about 1670 A.D. Local informants, again. They told us there would be one on the bottom of Lake Malone, when the construction contractors were drawing down the lake during work above Lock A. Sure enough, there it was. I don't think another intact dugout has ever been found in the Tenn-Tom Waterway."

The canoe is safely back in the lab now, reposing in a soup of warm water and a wax solution that will infiltrate the wood cells and preserve the canoe.

The next stop was at a controlled surface collection at a midden site north of Fulton near Lock D.

"This is another one that we learned about from the local people," Judy said. "They've been picking up artifacts here for years."

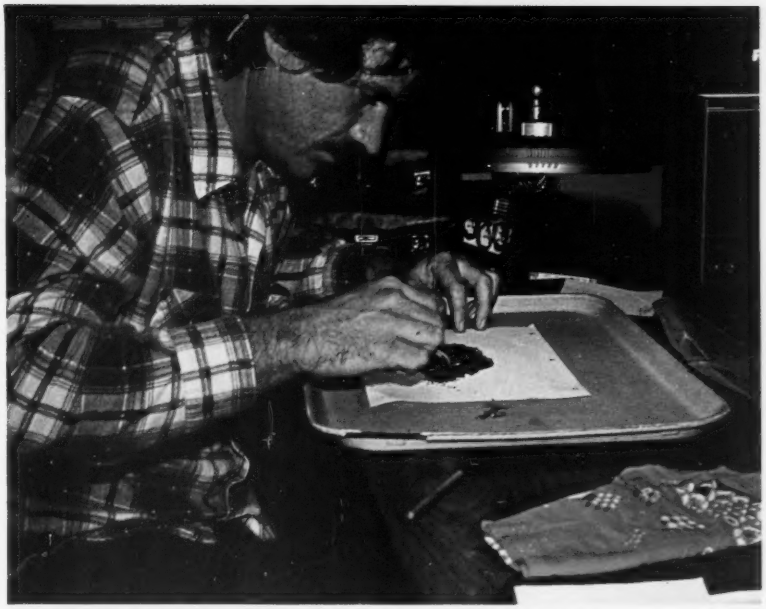
The site is located on a bluff overlooking the valley floor of the waterway and the massive levee that is being constructed.

July talked while laying out the gridline that would form the base for collection. She used a compass to insure that the initial stretch of engineer tape would be oriented on a north-south axis, then constructed smaller 4-meter square grids from the baseline. Each grid was letter identified so that artifactual material could be plotted relative to the north-south axis.

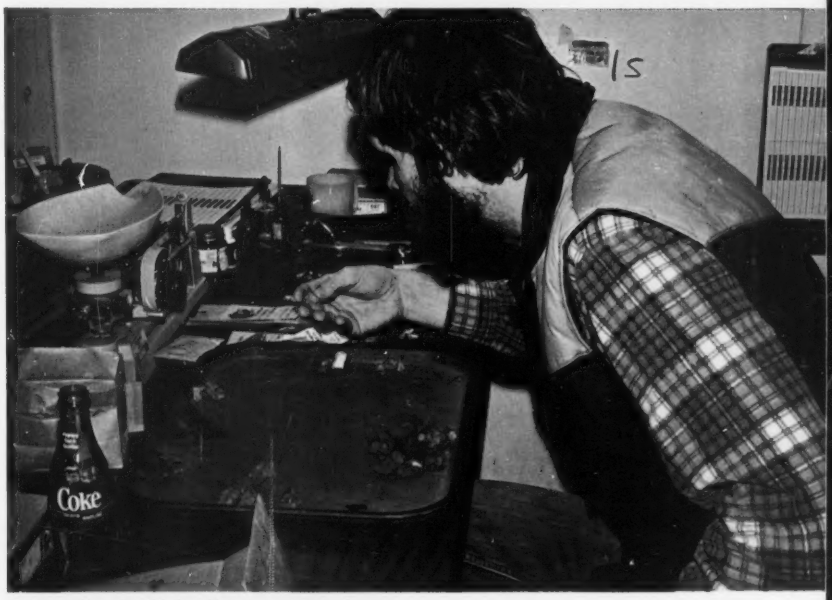
"We'll get right down on our hands and knees inside these squares and really comb the ground. This gives us a pretty good indication of what is underneath the surface . . . a good feel for whether or not the site has got promise for full excavation.

"When you come into one of these areas, after the initial bookwork and talking to the local people, you do a lot of preliminary observations. You look for site attributes, places where Indians should have lived or worked.

"You look for high ground near a permanent water source, for one thing. They liked to live where they didn't get their feet wet. You look for surface artifacts, black soil that in-



A lab technician prepares excavated organic material for carbon-14 dating. All lab findings are computerized to facilitate future retrieval and to alleviate the need for total artifact curation.



Lab co-director Blaine Ensor rough sorts artifactual materials into sub-categories prior to further analysis.

dicates charcoal, red soil that shows evidence of being fired. Some sites are easy to see, rock shelters for example. Others require the expert eye. A site might manifest itself as an earth mound or wall, a round depression in the ground, or soils that are of a different color than their surroundings. There may be evidence of human habitation right on the surface when you are lucky: chips of worked stone, pottery fragments, charred bone, etc. We note all this on the survey maps and it gives us a good start.

"You obviously don't have time to excavate all potential sites, so the survey is really a weeding out process. It helps determine where your resources should be be employed. On this project, after the survey, we excavated four sites and tested an additional seven. This is a typical proportion in salvage archeology. The salvage archeologist, by definition, can never hope to totally excavate all the sites that will be impacted. We don't have the luxury of time. We try to get a representative sampling, in order to demonstrate the succession of cultures and cultural patterns through time."

As she finished her grid, the controlled surface collection began in earnest, with half a dozen archeologists on hands and knees filling plastic bags with the memorabilia of the past.

"Surface collecting is a predictive tool," Judy explained, "and you pray for rain. After the surface collection, the testing begins. We strip off the overburden to a depth of about six inches to get a look underneath."

Our next stop was at a full-scale excavation at a prehistoric village site further north in the Mackey's Creek area. This, too, was on a terrace above water. It was opened in October 1980, as the third major excavation under the University of West Florida's contract with the Mobile District. It was heavily wooded.

"We stripped off the foliage here first," field director Joe Studer told us. "Then we dug a deep stratigraphic trench across the grid to expose any features that may have been there. By features, I'm talking about manmade anomalies other than artifacts—pits, hearths, postmolds (holes dug for logs that formed the superstructures of buildings).

"Feature presence tells you in what areas to dig . . . where you are most

This dugout canoe, which was dated to about 1690, was recovered during the drawdown of Lake Malone for construction of the Tenn-Tom's Lock A. The canoe has been preserved for public display.
(Photo by Dr. Bense)

apt to find occupations." Joe was concerned about the "coming water" also. "We've got to get in here and get out quickly, so we've got to make some educated guesses as to which sites are going to be most profitable. You can't dig them all . . . you have to make what you hope are the most profitable selections."

Judy added, "The research design posed some questions for us that we are trying to answer. You can only do this by digging. What were the cultural activities during the identified occupation of the valley? Were they sending out deer-hunting parties that returned to a base camp? Were they subsisting on shellfish? What caused the transition from one major cultural period to another? What caused Archaic Man to become Woodland Man? Where did the knowledge of ceramic culture come from and when?

"You nail down answers to these questions, and others, and you have made a contribution. These sites are going to be under a column of water before long, and before that happens we want to be able to know how these early people lived."

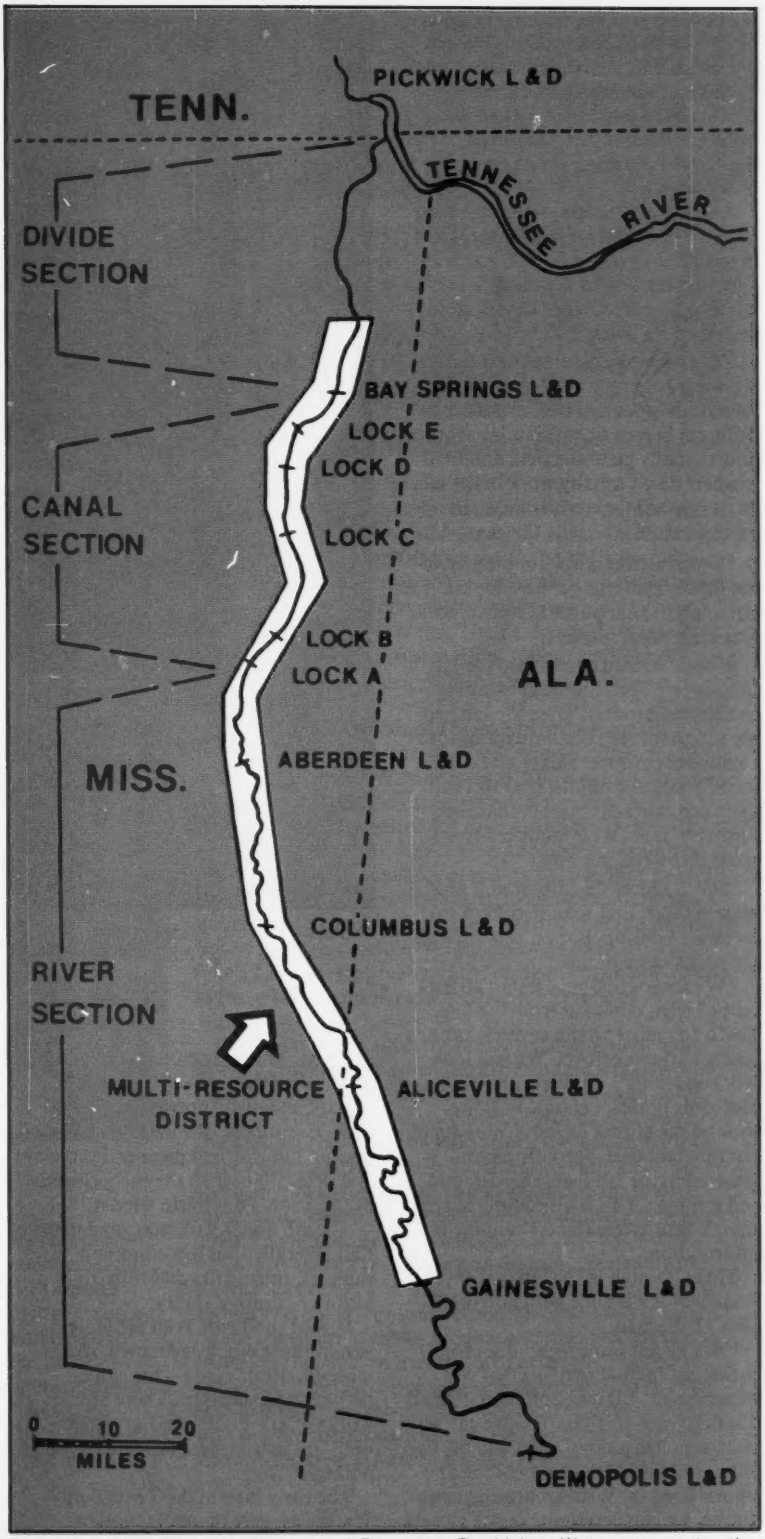
Dr. Bense showed the author another site, the Beech Site, that she had been led to by a local informant in August 1980. ("Thank God for the potbellied stoves," she reiterated.)

The Beech Site is 60 meters on a north-south axis by 30 meters on an east-west axis. Although some amateur digging was evident on the site, it was neither deep nor extensive. There was evidence of occupation over several thousand years, from Late Archaic through Mississippian Period. The site provides information on settlement patterns, subsistence, and trade networks that enable the archeologists to formulate some answers to the research design questions.

"Do you have a dog?" Judy asked me.

"We have excavated dog bones from about 4000 B.C., and this must mark the earliest domestication of an animal in the Tenn-Tom Basin. What purpose did they serve? I don't know. Watch dogs, food source, pets? We can't tell. All we know is that the people had tame dogs, within their encampments, 6000 years ago.

"After lab analysis, we are going to be able to tell you a hell of a lot about these people. How they used their environment . . . whether or not they lived in permanent camps and sent out hunt-



Tombigbee Multi-Resource District and Tennessee-Tombigbee Waterway construction area.

ing parties. Was each family responsible for its own food foraging? When did reliance on maize come into being? Because of the dearth of burials we can't tell you what they looked like, but we will know how they lived. After the Tenn-Tom reaches full pool, that is all we have left."

And then to the lab, where the field work—the trowel work—is translated in scientific hypothesis.

Blaine Ensor and Jerry Galm are the lab directors for the project. Blaine described his work:

"We normally assume two hours of lab work for every hour spent in the field. Lab types and field types are two different breeds of cat; our lab workers don't usually go in the field and field workers don't usually work in the lab. In the limited time available, such specialization is usually the case.

"When artifacts are popping up in the field rapidly we get behind, but it is our analysis that puts the recovered materials in perspective."

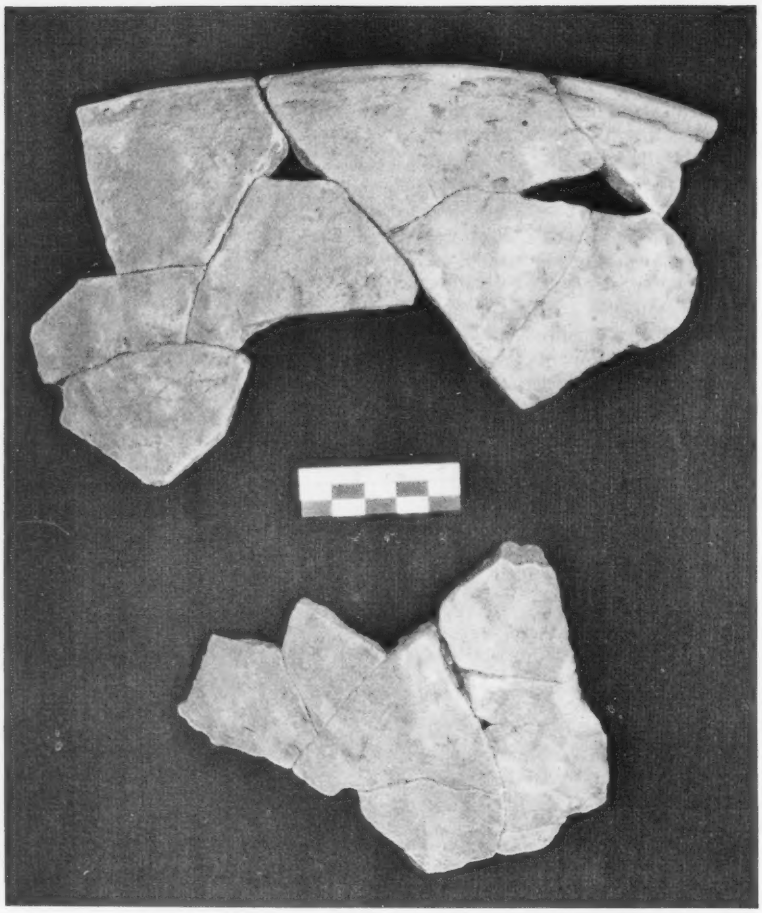
When material comes into the lab, it first undergoes a thorough washing and drying process. Then the lab people rough sort the accumulations into component groups: flakes and cores, tools, projectile points. ("Don't call them arrowheads," he emphasized. "Most of them were launched from spear throwers, not bows.")

"We'll segregate carbon and faunal material too, and send it off for carbon-14 dating. Bones, too, provide for pretty close dating.

"We try to catalogue about 20 percent of what comes in from the digs. To do any more would severely tax any future curative efforts. We will look for 'good stuff'; representative, intact projectile points, ceramic pots [he showed the author an early Woodland pot that had been partially reconstructed in the lab from sherds], and soil samples. This is all computerized so that future researchers can retrieve information."

There is a sign in the lab that says "Archeology is done with mirrors." Don't believe it.

"We've got some techniques for dating artifactual remains that will amaze you," Blaine continued. "In addition to carbon-14 dating, we can send out for pollen analysis that will tell us about the floral environment the aborigines lived in. With archeomagnetic dating, we can determine pretty closely when clay was fired. When it's fired, the molecules align themselves with magnetic north, and tables are being established that can tell us where, exactly, magnetic north was through time. Eventually, it will be possible to take an undisturbed piece of fired clay and determine when the early citizens of the Tenn-Tom Basin fired it."



This early ceramic vessel has been partially reconstructed in West Florida University's lab for sherds (fragments) recovered during excavation in the Tenn-Tom basin.
(Photo by Dr. Bense)

The lab was full of recovered materials, literally tons including soil samples, raising the question of ultimate curative ability.

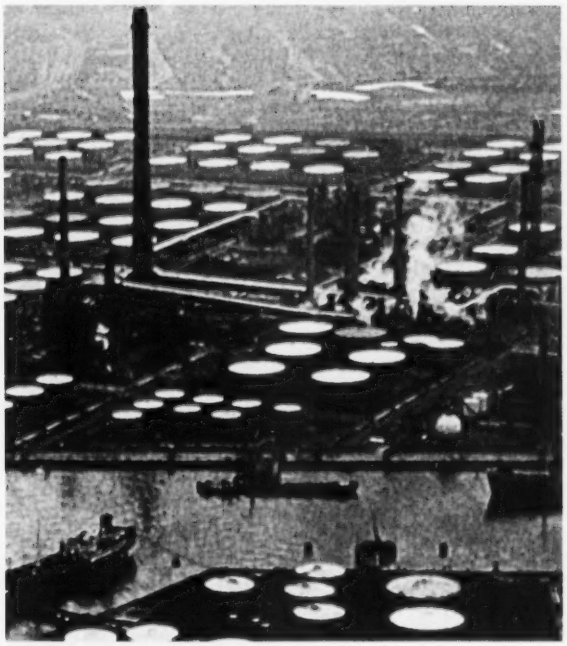
Few of the Tenn-Tom artifacts would cause much excitement in a museum display case—the canoe perhaps an exception. There are no works of art, no "King Tut's treasure," no masterpiece of statuary or pottery.

The early men in the Tenn-Tom Waterway were basically hunters, gatherers, and farmers. Their artifactual remains—all that is left—are dull and relatively unimpressive to the untrained eye—pottery fragments, broken tools, crude ornaments.

Yet, the study and analysis of these artifacts is crucial to understanding the region's past. As Dr. Bense repeated continually, "We are trying to understand and preserve the folkways of a people's past . . . a people that are gone forever . . . and the water is coming." ■

Editor's Note: This is the second article demonstrating the Corps of Engineers' concern with mitigation through archeology. The first, "Impounding the Past" (See Water Spectrum, Spring 1979*), dealt primarily with underwater archeology in areas where impoundment had already taken place. In this article, salvage archeology prior to impoundment is discussed.*

Events, Deeds & Deliberations



ACID RAIN BECOMING A WORLDWIDE PROBLEM

Acid rain has reached even the most remote areas of the world, according to University of Virginia environmental scientist Dr. James N. Galloway. Galloway's 18-month project, which collected rain samples from such areas as a South American rain forest and a barren island in the Indian Ocean, shows that global precipitation is far more acid than has been known, and fossil fuel pollutants from industrial areas are reaching even isolated areas where only minimal effects of acid rain had been expected. Acid rain is formed when pollutants from automobile exhausts and coal-burning industries combine with precipitation to form sulfuric and nitric acids.

Acid rain is blamed for damage to the 327-year old Taj Mahal in India. Damage to the monument's white marble includes some areas etched gray by the rain, with other portions a rough buff color. The Taj Mahal is located near two coal-fired power stations, about 250 foundries, and a railroad switching yard that uses coal-burning locomotives.

Acid rain is also blamed for extensive damage to Rome's marble monuments. Predictions indicate that 80 percent of the historic sculptures will be destroyed by the year 2000 if protective measures are not taken. Automobile exhaust is blamed for causing the acid rain that eats away the marble, turning it into a chalky, crumbly substance. Legislation appropriating $215 million to clean the monuments and protect them from further damage is stalled in parliamentary debates. Fearing that the statues will be destroyed before the legislation is passed, city officials have covered many of the ancient works with cloth cages, which could remain in place for as long as 20 years.

Control of acid rain is the major change to be sought by environmentalists when the 97th Congress reviews the Clean Air Act. The National Clean Air Coalition, composed of a number of environmental groups, has said it will seek legislation that would attack the acid rain problem by setting stricter levels for sulfur dioxide and nitrogen dioxide emissions and by requiring the Environmental Protection Agency to set a national ambient air quality standard for fine particulates.

An interagency task force on acid rain, created by the Energy Security Act of 1980, was to report to Congress in January on a plan for long-term monitoring and research on the transport of sulfur dioxide and nitrogen emissions, as well as research on the effects of acid rain on natural resources. The task force supports consolidation of Federal acid rain research and coordination of Federal work with private corporate research. (*Water News,* Virginia Water Resources Research Center, February 1981) □

NORTHEAST WATER SHORTAGES PLANNED FOR

This past winter's widespread water shortages are a signal for water supply planners to buckle down to long-range planning and improvements to delivery systems, said a group of water supply experts from the New England states, New York, and hard-hit New Jersey.

The planners, hydrologists, and water supply engineers participated in a panel discussion on "Drought in the Northeast," during the 57th quarterly meeting of the New England River Basins Commission in Boston, March 18.

Since the mid-sixties' drought, the drought of record in many northeastern states, several factors have amplified the adverse effects of below average precipitation. Increased incidence of chemical contamination of groundwater, higher per capita consumption of water, and larger populations all contribute to the strain on water supplies. The panelists were encouraged by the development of more sophisticated methods for predicting precipitation and runoff which allow water suppliers to respond to water shortages with appropriate emergency measures. Voluntary conservation measures can reduce water consumption, and many communities in the northeast are considering or implementing ways to improve the supply systems by detecting leaks, raising water rates, and rationing water during supply shortages.

A major factor in the present water shortage is evapotranspiration, the movement of water from lakes and reservoirs and from plants and soil into the atmosphere. During the 1960s drought, for example, evapotranspiration was 15 to 20 percent above normal, explained Albert Kachic, Regional Hydrologist with the National Weather Service. But this year, the evapotranspiration rate has been 15 to 100 percent above normal. This means that the combined effect of a 15 to 20 inch rainfall deficiency and high evapotranspiration rates of another 10 to 15 inches is equivalent to a 25 to 30 inch rainfall deficit in a 12-month period, more than half the normal 42-inch annual rainfall in New England.

"The evapotranspiration problem is devastating," said Joe Miri, from the Department of Environmental Protection in New Jersey. "Not only is the runoff greatly reduced, but you have the whipsaw effect of everyone out watering their lawns because of the tremendous evapotranspiration. That is what we were faced with last summer." □

RULES FOR MINING ON NATIONAL WILDLIFE REFUGES PROPOSED

Rules designed to control the environmental impacts of mining on national wildlife refuges have been proposed by the Fish and Wildlife Service. An environmental assessment on the proposal has been prepared.

The proposed rules apply to metallic and non-metallic minerals such as gold, lead, uranium, and borax, but do not include leasable minerals such as oil, gas, or coal, or saleable minerals such as sand and gravel. The proposed rules do not apply to national wildlife refuges in Alaska.

Under the proposal published in the December 31, 1980, *Federal Register,* operators of mines that may cause appreciable environmental disturbance will be required to prepare a plan describing measures to be taken to protect fish, wildlife, and their habitats, and to appropriately reclaim disturbed areas. The refuge manager or a Service mineral specialist will then study the proposed mining operation and its effects upon the fish, wildlife, and habitats of the refuge. The mining plan will be approved if it provides for adequate conservation and reclamation measures. □

MANATEE MORTALITY INCREASED DURING COLD WEATHER

Cold weather has again taken its toll on the endangered manatee in Florida. During January and February of this year, 41 dead manatees were reported to the U.S. Fish and wildlife Service Gainesville Laboratory, according to Dr. Jim Baker, the Service's manatee coordinator. This is the highest number reported since the same period in 1977 when 44 dead manatees were found. Both 1977 and 1981 were exceptionally cold during these two months in Florida.

Manatees become stressed when water temperatures drop below 70 degrees Fahrenheit. When the weather turns cold, they congregate near the warm outflows of power plants or natural warm water springs. However, if they exhaust their food supply of aquatic vegetation in these areas, they are forced to forage in colder water. While they may survive the cold period itself, they may succumb later to pneumonia or other stress-related diseases.

The winter range of this endangered species, whose U.S. population is currently estimated to number about 1000, is mainly the Florida peninsula. During the summer months, it extends northward to the state's panhandle on the Gulf Coast and up to North Carolina on the Atlantic Coast. □

WATERPOWER '81

Waterpower '81, the second federally sponsored international conference on hydropower, takes place 22–24 June in Washington, D.C. The conference is hosted by the U.S. Army Corps of Engineers in cooperation with other Federal agencies. The theme is "Energy Development in a Changing World." Two years ago, Waterpower '79 focused on small-scale hydropower. This year's conference focuses on the international perspective on hydropower as

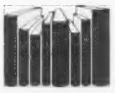
a renewable energy source and as an appropriate small and large technology. The program is organized around concurrent plenary sessions conducted by the sponsoring and cooperating agencies and tutorial workshops headed by experts from both government and industry. The technical program consists of paper sessions in engineering projects and equipment, impact analysis, international issues, and small-scale hydropower.

Energy costs have escalated dramatically. Economic pressures on developing countries as well as on North America, Western Europe, and Japan are forcing governments and private industry to explore new alternatives to meet energy demands. According to recent estimates the U.S. has developed only half of its hydropower potential, and the world only one tenth. The conference brings together representatives from governments, international agencies, private interests, and the academic community to exchange views and explore current plans to develop hydroelectric power. □

REMOTE SENSING SYMPOSIUM SCHEDULED

The Corps of Engineers Remote Sensing Symposium will be held November 30 through December 2 in Nashville, Tennessee. The symposium is intended to encourage increased application of remote sensing technology and to stimulate an exchange of information on all aspects of this interdisciplinary field.

The symposium will focus on the utilization of remote sensing techniques in the monitoring, assessment, and management of water resources. Technical sessions will address new or innovative techniques and methodologies, advanced sensor and data acquisition design, and advanced data processing analysis capabilities. Multidisciplinary poster sessions will document the operational use of the technology in discipline or mission-oriented projects. □



Bookshelf

Water Quality Management, by Peter A. Krenkel and Vladimir Novotny, is a broad reference work for protectors and beneficial users of water resources. Coverage includes fundamentals of water quality; water quality modeling and systems analysis of streams, reservoirs, and estuaries; and practical water quality problems such as eutrophication, thermal pollution, outfall design, and groundwater pollution. The book is available from Academic Press, Inc., 111 Fifth Avenue, New York, NY 10003, for $65.

Project Data, published by the Department of the Interior Water and Power Resources Service, a revision of earlier data books, presents histories and summaries of all Service projects, including those completed and in operation, under construction or proposed. This 2,463-page volume combines the contributions of engineers, scientists and technicians throughout the Service to provide an overall view and history of the organization (formerly known as the Bureau of Reclamation) from its inception in 1902. This illustrated manual is available for $21 from the Water and Power Resources Service, Attention: D-922, P.O. Box 25007, Denver, CO 80225.

America's Soil and Water: Condition and Trends, published by the U.S. Department of Agriculture's Soil Conservation Service, is a booklet describing the current state of the nation's non-federal lands and problems of erosion, loss of prime farmlands and wetlands and the expansion of irrigation even as many water tables are falling. The booklet can be obtained from county offices of the Soil Conservation Service and from the SCS Information Division, room 0054-S, USDA, Washington, DC 20250.

Colorado River Salinity—Economic Impacts on Agricultural, Municipal and Industrial Users, compiled by researchers and economists from the Water and Power Resources Service of the Department of the Interior, and a consortium of western universities, is a report documenting damages from Colorado River waters which are increasing in salinity as a result of increasing pollution by mineral salts. Copies of this 19-page report are available by writing to the Chief, Colorado River Water Quality Office, Water and Power Resources Service, P. O. Box 25007, Denver, CO 80225.

Assateague Island National Seashore, published by the National Park Service, is a three-section handbook prepared as part of the Service's observation of the Year of the Coast. The book begins with a general introduction to the island which describes its early history and captures the mood of present-day Assateague. Part Two is an examination of the island's natural history written and illustrated by William H. Amos. The handbook concludes with a section that offers practical information for the visitor and tips on biking, clamming, surf fishing, canoeing, special events and other activities available on the island. The 176-page handbook is priced at $4.95 and can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The stock number is 024-0005-0076-8.

Water Resources Planning in New England, by Stuart G. Koch, focuses on one policy area in one geographical setting to examine the impact of citizen participation on the quality of U.S. public policy and official accountability. Publisher is the University Press of New England, Box 979, Hanover, NH 03755. Price is $12.

Engineering for Water Supply in a New and Developing Regulatory Climate is a 132-page compilation of 15 papers presented at the Twenty-Second Annual Public Water Supply Engineer's Conference. Topics covered include new environmental and energy constraints; new approaches to the determination of health effects; and the impact of the new regulatory climate on design, financing, management, and operation of water treatment facilities. Copies of the proceedings are available for $10 from the Engineering Publications Office, University of Illinois at Urbana-Champaign, 112 Engineering Hall, 1308 West Green Street, Urbana, IL 61801. □

Coming Events

Water Reuse Symposium II, Washington, DC, August 23–28.

Oceans 81, Sheraton Boston Hotel, Boston, MA, September 16–18.

7th Annual Conference of the Coastal Society, Hotel Galvez, Galveston, TX, October 11–14. □

Changes of Command

Colonel Alfred B. Devereaux, Jr., has been named district engineer of the Jacksonville District, Jacksonville, Florida, effective in July. He succeeds **Colonel James W. R. Adams.** Colonel Devereaux previously served as commander and director of the Corps' Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Colonel Ronald E. Hudson became district engineer of the Norfolk District, Norfolk, Virginia. He succeeds **Colonel Douglas L. Haller.** Colonel Hudson was previously director of engineering and housing, Headquarters, V Corps, Frankfurt, Germany.

Colonel Jonathan D. Nottingham has become district engineer of the Japan District, Camp Zama, Japan. He succeeds **Colonel Ralph A. Luther.** Colonel Nottingham was formerly the assistant director of Civil Works for the Great Lakes and Upper Mississippi River, Civil Works Directorate, Office of the Chief of Engineers, Washington, D.C.

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Colonel Howard H. Roberts, Jr., becomes New Orleans district engineer, New Orleans, Louisiana, in July. He succeeds **Colonel Thomas A. Sands.** Colonel Roberts was the deputy chief of staff for Plans and Programs, U.S. Army Combined Arms Center, Fort Leavenworth, Kansas.

Colonel Gene A. Schneebeck was named district engineer of the Al Batin District, Al Batin, Saudi Arabia. He succeeds **Colonel Milton L. Little.** Colonel Schneebeck's previous assignment was assistant director of military programs for Israel Air Bases and Air Force programs, Office of the Chief of Engineers, in Washington, D.C.

Colonel Bernard P. Slofer has been named district engineer of the Rock Island District, Rock Island, Illinois, effective in July. He succeeds **Colonel Frederick W. Mueller, Jr.** Colonel Slofer previously served as senior Army advisor to the Maine Adjutant General and Army National Guard in Augusta, Maine.

Colonel Paul W. Taylor became district engineer of the Los Angeles District, Los Angeles, California, in July. He succeeds **Colonel Gwynn A. Teague.** Colonel Taylor formerly served as area engineer and contracting officer at Ramon Air Base, Israel.

Lieutenant Colonel John L. Richards was named Pittsburgh district engineer, Pittsburgh, Pennsylvania, effective in July. He succeeds **Colonel Joseph A. Yore.** Lieutenant Colonel Richards was assigned as chief of the Structural Analysis Section in the Defense Intelligence Agency in Washington, D.C.

Secretary of the Interior James Watt has appointed **Robert N. Broadbent** of Boulder City, Nevada, as Commissioner of the Department of the Interior's Water and Power Resources Service, commonly known as the Bureau of Reclamation.

William R. Murden, chief of the Corps' Dredging Division, was made an honorary life chairman of the board of the World Dredging Association in recognition of his outstanding service, personal effort, dedication and leadership in the successful restructuring of the association. The award was given to Mr. Murden as he stepped down from his eight-year post as chairman of the association.□

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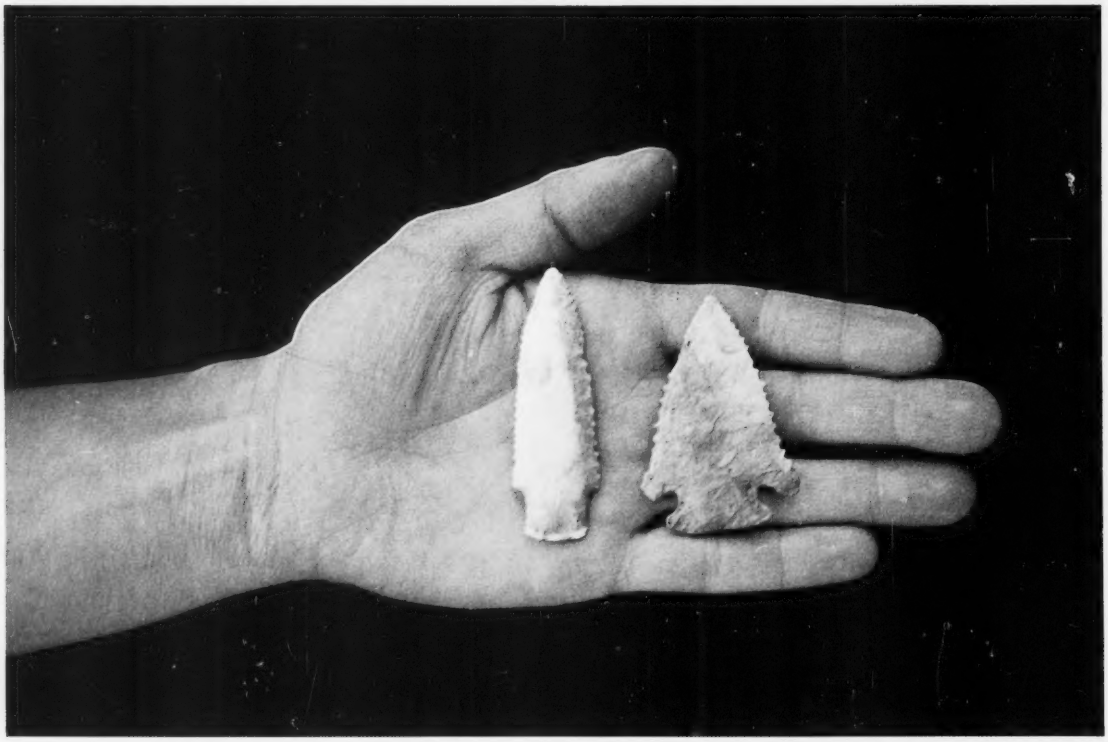
Representative projectile points from the Tenn-Tom impact area that were salvaged ahead of the oncoming water. Projectile points are among the most easily datable artifacts unearthed by the archeologists. *See "Preserving the Past" on page 39.*
(Photo by Judith Bense.)